

Academic programme  
component

31.05.01 General Medicine  
programme

Б1.0.14  
discipline code

## SYLLABUS

Discipline Chemistry

---

Author(s):  
Sagaidachnaya V.V.

Associate Professor

Ph.D. in Pedagogy,  
Docent

Approved at the meeting of the  
Chemistry Department

Record no. \_\_\_ dated

Head of the department Dyakina T.A.

\_\_\_\_\_  
signature

Murmansk

2024

## Clarification

Discipline volume: 2 credit points

**1. Discipline (module) training results** correlated with the indicators of competencies achievement determined by the educational programme

Competency	Indicators of competency achievement	Discipline (module) training results
<p><b>УК-1:</b> Can design action plans and apply systematic approach to critical analysis of problem situations</p>	<p>ИД-1<sub>УК-1</sub> Applies a systematic approach in search and analytical activities to solve assigned problems</p>	<p><b>To know:</b> – theoretical foundations of general, analytical, organic and physical and colloidal chemistry; – patterns of chemical processes; – properties of chemical systems; – chemistry of the most important biogenic elements.</p> <p><b>To be able to:</b> apply chemical knowledge, theories, laws, concepts to master special disciplines and solve professional problems; apply chemical methods for studying inorganic and organic compounds to solve professional problems.</p> <p><b>To have:</b> – knowledge of a complex of chemical methods of research, processing and analysis of experimental data; – skills in safe handling of chemical reagents, instruments and laboratory equipment</p>

## 2. Discipline contents

### Unit 1. General and inorganic chemistry

**Topic 1.1.** Chemistry as a science. Basic concepts and laws of chemistry. Classification and properties of inorganic compounds. Calculations using formulas of chemical compounds and chemical equations. Basic principles of chemical reactions.

**Topic 1.2.** The structure of the atom. Periodic law of D.I. Mendeleev. Chemical bond.

**Topic 1.3.** Solutions.

Formation of solutions. Chemical theory of solutions D.I. Mendeleev. True solutions. Types of concentrations: mass fraction, molarity, normality, titer.

Electrolyte solutions. Electrolytic dissociation. Arrhenius theory. Degree of dissociation, dissociation constant. Hydrogen pH indicator. pH calculations. Buffer solutions.

Hydrolysis of salts. Degree and constant of hydrolysis.

Product of solubility. Solubility. Factors affecting solubility.

**Topic 1.4.** Redox properties of substances. The role of the environment in redox reactions.

**Topic 1.5.** Coordination complexes. Basic provisions of coordination theory.

**Topic 1.6.** General characteristics of non-metals. Hydrogen. Halogens. Oxygen group. Nitrogen group. Carbon group. Group III-A elements.

**Topic 1.7.** General characteristics of metals. General properties of metals. S-block metals. D-block metals.

## **Unit 2. Analytical chemistry**

**Topic 2.1.** Theoretical fundamentals of analytical chemistry

Methods of analytical chemistry. Conditions for analytical reactions. Sensitivity, specificity, ways to increase the sensitivity of analytical reactions. Fractional and systematic course of analysis.

Chemical equilibrium in homogeneous systems. Hydrogen and hydroxyl indicators. Buffer solutions.

Heterogeneous systems. Product of solubility. Factors affecting the solubility of precipitation. Conditions for the formation and properties of crystalline deposits, rules of precipitation.

**Topic 2.2.** Qualitative chemical analysis

Qualitative chemical analysis of anions and cations. Rules for separating cations and anions of different groups.

Acid-base method of separating cations. Anion detection reactions. Particular reactions and progress in the analysis of a mixture of cations and anions.

**Topic 2.3.** Quantitative chemical analysis

Gravimetric analysis (plan, basic reaction equations, areas of application).

Titrimetric method of analysis (plan, basic reaction equations, working solutions, indicators, areas of application).

Acid-base titration (basic reaction equations, working solutions, indicators, applications).

Permanganatometry and iodometry (basic reaction equations, working solutions, indicators, areas of application). (basic reaction equations, working solutions, indicators, applications).

Instrumental methods of analysis.

## **Unit 3. Physical chemistry**

**Topic 3.1.** Thermodynamics and chemical equilibrium

Work and heat as properties of the process. Internal energy and enthalpy. First law of thermodynamics. The concept of heat capacity. Hess's law.

Reversible and irreversible processes. Entropy. Second law of thermodynamics. Entropy as a measure of determining the direction of processes and equilibrium conditions. Gibbs energy.

**Topic 3.2.** Real solutions. Activity of solvent and solute. Ionic strength of the solution. Henry's Law. Freezing and boiling points of solutions. Cryoscopy and ebullioscopy as methods for determining the molecular mass of a substance.

Osmosis. Osmotic pressure. Van't Hoff equation. Ostwald's law of breeding.

**Topic 3.3.** Electrochemistry fundamentals.

Basic conditions for carrying out the reaction electrochemically. Standard electrode potential. Nernst equation. Galvanic cell. Electrolysis. Laws of electrolysis.

**Topic 3.4.** Chemical kinetics and catalysis. Basic concepts of chemical kinetics. Speed reaction. Law of mass action. Activation energy. Catalytic reactions. Catalysis.

## **Unit 4. Organic chemistry**

**Topic 4.1.** Basic concepts, theories, laws of organic chemistry.

Basic principles of the theory of the structure of organic compounds. Valence. Homologous series. Types of structural fragments of organic molecules. Structure of organic compounds, structural and spatial isomerism. Types of organic reactions.

**Topic 4.2.** Hydrocarbons: saturated, unsaturated, alicyclic, aromatic.

Alkanes and their derivatives. Homologous series, nomenclature and isomerism. Chemical properties of methane and its homologues. Cycloalkanes.

Alkenes. Nomenclature, isomerism. Methods for forming a double bond. Dehydrogenation. Ethylene and its homologues. Polymerization reaction.

Alkynes. Methods for forming a triple bond. Chemical properties and production of alkynes.

Aromatic hydrocarbons (arenes). Benzene. Electronic structure and chemical properties of benzene. Alkylbenzenes, structure, properties and methods of preparation.

**Topic 4.3.** Oxygen-containing organic compounds.

Alcohols, classification. Methanol and ethanol, chemical properties, preparation and application. Polyhydric alcohols: ethylene glycol and glycerin. Phenols.

Aldehydes and ketones, chemical properties, preparation and application.

Carboxylic acids. Esters. Fats.

**Topic 4.4.** Biopolymers: carbohydrates, lipids, proteins, nucleic acids.

Carbohydrates: monosaccharides, oligosaccharides, polysaccharides. Structure, properties, functions in the body, qualitative reactions.

Lipids: fats and lipoids. Saturated and unsaturated fats. Structure, properties, functions in the body, qualitative reactions.

Amino acids. Proteins: structure, properties, functions in the body, qualitative reactions. Synthesis of polypeptides, features of protein biosynthesis.

Nucleic acids: DNA and RNA. Structure, properties, functions in the body, qualitative reactions.

### **Unit 5. Colloid chemistry**

**Topic 5.1.** Colloidal chemistry. General characteristics of disperse systems and their classification. Stability of colloidal systems.

Molecular-kinetic, optical and electrical properties of colloids. Structure and charge of colloidal particles. Properties of surfactants.

**Topic 5.2.** Chemistry of macromolecular compounds (MCCs).

General concepts of the chemistry of macromolecular compounds. Classification and nomenclature. Structure, properties and production of polymers. Rubbers. Plastic masses. Synthetic fibers.

### **3. Training support materials**

- multimedia presentations on the discipline are available on MAU LMS Moodle;
- practical training manuals are available on MAU LMS Moodle;
- learning materials are available on MAU official website at [«Информация по образовательным программам, в том числе адаптированным»](#).

### **4. Discipline assessment materials**

- Discipline assessment materials is a separate document within the educational programme, presented at [«Информация по образовательным программам, в том числе адаптированным»](#) section on official MAU website; it includes:

- a list of competencies indicating the stages of their achievement within the discipline;
- formative assessment tasks;
- interim assessment tasks;
- tasks for internal assessment of education quality.

**5. The list of main and supplementary literature** (printed sources, electronic textbooks and (or) resources of Digital Library Systems)

***Main literature:***

*Unit 1. General and inorganic chemistry*

1. Glinka, N. L. *Obschchaya khimiya* [Tekst] : ucheb. posobie dlya vuzov / Glinka N. L. ; pod red. V. A. Popkova, A. V. Babkova. - 18-e izd., pererab. i dop. - M. : Yurait, 2011-10. - 898 s. . <https://biblio-online.ru/book/obschchaya-himiya-v-2-t-388983>

2. Sagaidachnaya, V.V. *Obschchaya khimiya* [Tekst] : ucheb. posobie dlya stud. nekhim. spets. vuzov / avt.-sost. V.V.Sagaidachnaya; M-vo obrazovaniya i nauki RF, Murm.gos.gumanit.un-t. – Murmansk: MGGU, 2011. – 116 s. (15 copies)

*Unit 2. Analytical chemistry*

3. Khakhanina, T. I. *Analiticheskaya khimiya* : ucheb. posobie dlya bakalavrov [Tekst] / Khakhanina T. I., Nikitina N. G. - 3-e izd., ispr. i dop. - M. : Yurait, 2014. - 278 s. (10 copies)

*Unit 3. Organic chemistry*

4. *Organicheskaya khimiya* : ucheb. posobie dlya bakalavrov [Tekst]: ucheb. posobie dlya stud. vuzov / B.D. Berezin, D.B. Berezin . - 2-e izd. - M. : Yurait, 2012. – 767s. (5 copies)

*Unit 4. Physical chemistry*

5. Ippolitov, E. G. *Fizicheskaya khimiya* [Tekst]: uchebnik dlya stud. vuzov / Ippolitov E. G., Artemov A. V. i dr. ; pod red. E. G. Ippolitova. - M.: Akademiya, 2011. - 447 s. (13 copies)

*Unit 5. Colloid and polymer chemistry*

6. Shchukin E. D. *Kolloidnaya khimiya* : uchebnik dlya stud. vuzov, obuch. po spets. "Khimiya" / E. D. Shchukin, A. V. Pertsov, E. A. Amelina. - 5-e izd., ispr. - M. : Vysshaya shkola, 2007. - 444 s. (15 copies)

***Supplementary literature***

*Unit 1. General and inorganic chemistry*

7. Glinka, N.L. *Zadachi i uprazhneniya po obshchei khimii* [Tekst]: ucheb. posobie dlya vuzov / N.L. Glinka; pod. red. V.A. Rabinovicha, Kh.M. Rubinoi. – Izd. ispr. – M. : IntegralPress, 2011. – 240 s <https://biblio-online.ru/viewer/praktikum-po-obschey-himii-425855>

*Unit 2. Analytical chemistry*

8. *Analiticheskaya khimiya: uchebnoe posobie dlya vuzov* / A.I. Aparnev, G.K. Lupenko, T. P. Aleksandrova, A. A. Kazakova. — 2-e izd., ispr. i dop. — M.: Izdatel'stvo Yurait, 2018. — 107 s. [Elektronnyi resurs]. - Rezhim dostupa: [https://biblio-online.ru/book/analiticheskaya-himiya-423827?utm\\_campaign=rpd&utm\\_source=web&utm\\_content=a2e909a53993fb9c8302a00cb41b5c8b](https://biblio-online.ru/book/analiticheskaya-himiya-423827?utm_campaign=rpd&utm_source=web&utm_content=a2e909a53993fb9c8302a00cb41b5c8b)

### Unit 3. Organic chemistry

9. Ivanov, V. G. Organicheskaya khimiya [Tekst]: ucheb. posobie dlya stud. vuzov, obuch. po spets. "Biologiya" / V. G. Ivanov, V. A. Gorlenko, O. N. Geva. - 6-e izd., ster. - M.: Akademiya, 2010. - 620 s. (10 copies)

### Unit 4. Physical chemistry

10. Fizicheskaya khimiya: uchebnik dlya vuzov [Tekst]: v 2 kn. Kn.1-2. Stroenie veshchestva. Termodinamika / I. N. Godnev, N. K. Vorob'ev ; pod red. K. S. Krasnova. - 3-e izd., ispr. - M. : Vysshaya shkola, 2001. - 512, 319 s. (10 copies)

### Unit 5. Colloid and polymer chemistry

11. Tipovye raschety po fizicheskoi i kolloidnoi khimii [Tekst] [Tekst] : ucheb. posobie [dlya stud. vsekh napravl. bakalavriata] / Vasyukova A. N., Zadachina O. P., Nasonova N. V., Perepelkina L. I. - SPb. [i dr.] : Lan', 2014. - 144 s. (5 copies)

## 6. Professional databases and information reference systems

- 1) Information system "Single window of access to educational resources" - URL: <http://window.edu.ru>
- 2) Legal reference system. Consultant Plus - URL: <http://www.consultant.ru/>

## 7. The list of licensed and openly distributed software, including domestic software

- 1) Microsoft Office 2007 Service Pack
- 2) ABBYY FineReader Optical text recognition system
- 3) Microsoft Office 2010 Russian Academic OPEN Service Pack

## 8. Ensuring mastering the discipline for people with special needs

Students with special needs are provided with printed and (or) electronic educational resources adapted to their needs.

9. The material and technical support of the discipline (module) is presented in the appendix to the academic programme "Material and technical conditions for the implementation of the educational programme" and includes:

- classrooms for conducting training sessions provided for by the specialty programme, fitted with technical equipment;
- spaces for self-study work fitted with computer equipment with the Internet connection and access to MAU LMS Moodle.

It is allowed to replace the equipment with its virtual counterparts.

## 10. Study load distribution by type of educational activity

Table 1 - Study load distribution

Type of educational activity	The discipline (module) study load distribution by the forms of training						
	Full-time			Part-time		Distant	
	Semester		Total hours	Semester	Total hours	Semester	Total hours
	1						

Lectures	24			24									
Practical work	28			28									
Laboratory work	20			20									
Self-study work	36			36									
Preparation for interim assessment	36			36									
<b>Total hours on the discipline</b> / in the form of seminars	144			144									

Interim and formative assessment

Examination	+			+									
Credit/graded credit													
Course work (project)													
Number of calculation and graphic works													
Number of module tests													
Number of reports													

**The list of topics of practical work**

№	Seminar topics
<b>1</b>	<b>2</b>
	<b>Full-time</b>
1.	Fundamental chemistry laws. Chemical calculations.
2.	Quantitative composition of solutions.
3.	Oxidation and reduction
4.	General characteristics of non-metals
5.	General characteristics of metals
6.	Fundamentals of chemical thermodynamics
7.	Kinetics of chemical reactions
8.	Qualitative methods of analysis
9.	Acyclic hydrocarbons
10.	Oxygen-containing compounds
11.	Nitrogen-containing compounds
12.	Biopolymers: carbohydrates, lipids, proteins
13.	Lyophilic and lyophobic dispersion systems
14.	Final test on the discipline

**The list of topics of laboratory work**

№	Laboratory works
<b>1</b>	<b>2</b>
1-2	Main classes of inorganic substances: chemical properties and their preparation
3	Preparation of solutions
4	Qualitative analysis of cations
5	Qualitative analysis of anions
6	Kinetics of chemical reactions. Chemical equilibrium
7	Calorimetric determination of the heat of salt solution
8	Aliphatic hydrocarbons: preparation and chemical properties
9	Alcohols and phenols: preparation and chemical properties
10	Aldehydes and ketones: preparation and chemical properties