

Federal State Budgetary Educational Institution of Higher Education  
"Privolzhsky Research Medical University"  
Ministry of Health of the Russian Federation



## WORKING PROGRAM

Name of the academic discipline:

**INSTRUMENTAL METHODS IN ANALYTICAL CHEMISTRY (elective discipline)**

Specialty: **33.05.01 PHARMACY**

Qualification: **PHARMACIST**

Mode of study: **FULL-TIME**

Labor intensity of the academic discipline: **72 academic hours**

Nizhny Novgorod  
2021

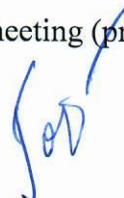
The working program has been developed in accordance with the Federal State Educational Standard for the specialty 31.05.01 General Medicine approved by Order of the Ministry of Science and Higher Education of the Russian Federation No. 988 of August 12, 2020.

**Developers of the working program:**

1. Piskunova M.S., Ph.D., Associate Professor,
2. Gordetsov A.S., Doctor of Chemistry, Professor, Head of the Department of General Chemistry.

The program was reviewed and approved at the department meeting (protocol No.1, 26.08.2021)

Head of the Department of General Chemistry,  
Doctor of Chemistry, Professor Gordetsov A.S.



/Gordetsov A.S./

August 26, 2021

AGREED

Deputy Head of EMA ph.d. of biology  Lovtsova L.V.

August 26, 2021

## **1. GOALS AND OBJECTIVES OF MASTERING THE DISCIPLINE**

The purpose of the discipline is to prepare students for the assimilation of biomedical and special disciplines, for which, on the basis of modern scientific ideas and in accordance with the requirements of the Federal State Educational Standard of Higher Professional Education, to form knowledge about use of physical research methods in analytical chemistry UK-1: The ability to carry out a critical analysis of problem situations based on a systematic approach, to develop an action strategy

GPC-1: the ability to use basic biological, physico-chemical, chemical, mathematical methods for the development, research and examination of medicines, the manufacture of medicines.

### ***The tasks of the discipline are:***

- acquisition and consolidation of knowledge in the field of analysis of analytical chemistry;
- formation of the ability to use modern methods for establishing the structure of compounds;
- acquiring the ability to work in a chemical laboratory using special equipment;
- formation of students' skills in studying scientific chemical literature;
- formation of students' skills for solving problematic and situational problems.

### ***As a result of mastering the discipline, the student must:***

#### ***Know:***

1. thermodynamic and kinetic patterns that determine the flow of chemical and biochemical processes;
2. physical and chemical aspects of the most important biochemical processes and various types of homeostasis in the body: theoretical foundations of bioenergetics, factors influencing the shift in the balance of biochemical processes;
3. properties of water and aqueous solutions of strong and weak electrolytes;
4. main types of equilibria and life processes: protolytic, heterogeneous, ligand-exchange, redox;
5. mechanisms of action of body buffer systems, their relationship and role in maintaining acid-base homeostasis; features of acid-base properties of amino acids and proteins;

6. patterns of physical and chemical processes in living systems from the point of view of their competition resulting from the combination of different types of equilibria;
7. the role of biogenic elements and their compounds in living systems;
8. physical and chemical bases of surface phenomena and factors influencing the free surface energy; features of adsorption at different phase boundaries;
9. features of physical chemistry of dispersed systems and solutions of biopolymers.

**Be able to:**

1. use measuring utensils, analytical balances; own the technique of performing basic analytical operations in the qualitative and quantitative analysis of a substance, prepare and standardize solutions of analytical reagents;
2. take an average sample, draw up an analysis scheme, conduct a qualitative and quantitative analysis of the substance within the limits of using the basic techniques and methods provided for by the program;
3. work with the main types of instruments used in analysis (microscopes, photoelectric colorimeters, spectrophotometers, pH meters, conductometers, etc.);
4. choose the optimal method for qualitative and quantitative analysis of the substance;
5. build titration curves and set on their basis the volumes of titrant spent on each component of the mixture;
6. carry out the separation of cations and anions by chemical and chromatographic methods;
7. conduct laboratory experiments, explain the essence of specific reactions and their analytical effects;
8. perform initial calculations, final calculations using statistical processing of the results of quantitative analysis;
9. draw up reporting documentation on experimental data;
10. independently work with educational, scientific and reference literature on analytical chemistry.

**Possess:**

1. technique of chemical experiments, conducting test-tube reactions, skills in working with chemical glassware and simple instruments;
2. technique for experimental determination of the pH of solutions using indicators and instruments;

3. the simplest operations when performing qualitative and quantitative analysis of substances;

4. technique of working on physical instruments used for qualitative and quantitative analysis (photoelectric colorimeter, spectrophotometer, pH meter, conductometer, etc.);

5. skills to conduct a systematic analysis of an unknown compound;

6. methods of statistical processing of experimental results.

## **2. Position of the academic discipline in the structure of the General Educational Program of Higher Education (GEP HE) of the organization**

2.1. The discipline "Instrumental Methods in Analytical Chemistry" refers to the basic part of block 1 "Elective disciplines" of the PEP HE. The discipline is studied in the IV semester.

2.2. To study the discipline, knowledge, skills and abilities are needed that are formed by previous disciplines: general and inorganic chemistry, physics, computer science, mathematics, physical and colloidal chemistry, analytical chemistry, organic chemistry.

2.3. The study of the discipline is necessary for the knowledge, skills and abilities formed by the subsequent disciplines of the professional cycle: biochemistry, toxicological chemistry and such professional disciplines as biological chemistry, pharmaceutical chemistry, pharmacognosy, toxicological chemistry.

## **3. RESULTS OF MASTERING THE DISCIPLINE AND INDICATORS OF ACHIEVING COMPETENCES:**

The process of studying the discipline is aimed at the formation of the following universal (UC), general professional (GPC):

№ п/п	Competence code	The content of the competence (or its part)	Code and name of the competence acquisition metric			
			know	be able to	possess	Evaluation tools
1.	UC-1	the ability to carry out a critical analysis of problem situations based on a systematic approach, to develop an action strategy	How to put into practice the methods of humanitarian, natural sciences, biomedical and clinical sciences in various types of professional and social activities	Analyze socially significant problems and processes	The methods of humanitarian natural sciences, biomedical and clinical sciences	Tests, multiply choice tests, colloquia, credits, exams
2.	GPC-1	the ability to use basic biological, physico-chemical, chemical,	How to apply the basic methods, methods and means of	Work with scientific literature analyze information,	Ability and willingness to participate	Tests, multiply choice tests, colloquia

		mathematical methods for the development, research and examination of medicines, the manufacture of medicines	obtaining storage, processing of scientific and professional information; receive information from various sources, including using modern computer tools, network technologies, databases and knowledge	conduct searches, turn what is read into tool for solving professional problems Use the rules for constructing chemical formulas, graphs, tables using appropriate computer programs, including for creating computer presentations.	in the formulation of scientific problems and their experimental implementation Computer programs for constructing chemical and stereochemical formulas of organic compounds and other types of illustrative material.	a, credits, exams
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#### 4. Sections of the academic discipline and competencies that are formed when mastering them

№ п/п	Competence code	Section name of the discipline	The content of the section in teaching units
1.			
1.	UC-1 GPC-1	Qualitative Analysis	<p><b>Qualitative chemical analysis.</b> Classification of qualitative analysis methods (fractional and systematic, macro-, semi-micro-, micro-, ultra-microanalysis). Analytical reactions and reagents used in qualitative analysis (specific, selective, group). The use of qualitative analysis in pharmacy. Analytical classification of cations by groups: hydrogen sulfide (sulfide), ammonia-phosphate, acid-base. Limitation of any classification of cations by groups. Acid-base classification of cations by groups. Systematic analysis of cations by the acid-base method. Analytical reactions of cations of various analytical groups. Qualitative analysis of anions. Analytical classification of anions by groups (according to the ability to form sparingly soluble compounds, according to redox properties). Limitation of any classification of anions by groups. Analytical reactions of anions of various analytical groups. Methods for the analysis of mixtures of anions of various analytical groups. Analysis of mixtures of cations and anions (qualitative chemical analysis of a substance). <b>Application of physical and physico-chemical methods in qualitative analysis</b> Optical methods of analysis: emission spectral analysis; flame photometry (flame photometry); molecular absorption spectral analysis (spectrophotometry) in the</p>

			ultraviolet and visible regions of the spectrum; infrared spectroscopy; other optical methods (refractometry, polarimetry, luminescent method of analysis). Chromatographic methods of analysis. Electrochemical methods of analysis.
2.	UC-1 GPC-1	Instrumental (physico-chemical) methods of analysis.	<p>General characteristics of instrumental (physico-chemical) methods of analysis, their classification, advantages and disadvantages.</p> <p><b>Optical methods of analysis</b></p> <p>General principle of the method. Classification of optical methods of analysis (according to the objects under study, by the nature of the interaction of electromagnetic radiation with matter, by the region of the electromagnetic spectrum used, by the nature of energy transitions).</p> <p>Molecular spectral analysis in the ultraviolet and visible region of the spectrum</p> <p>The essence of the method. Color and spectrum. Basic laws of Bouguer's light absorption. The combined Bouguer-Lambert-Beer light absorption law. Optical density (A) and light transmission (T), the relationship between them. Light absorption coefficient (k) and extinction coefficient - molar (<math>\epsilon</math>) and specific (E1% 1cm); relationship between molar extinction coefficient and light absorption coefficient (<math>k = 2.3 \epsilon</math>), optical density additivity, reduced optical density. Schematic diagram of obtaining the absorption spectrum. The concept of the origin of electronic absorption spectra; features of electronic absorption spectra of organic and inorganic compounds.</p> <p>Absorption analysis methods; colorimetry, photoelectrocolorimetry, spectrophotometry.</p> <p>Colorimetry. Standard series method, color equalization method, dilution method. Their essence. Application in pharmacy.</p> <p>Photocolorimetry, photoelectrocolorimetry. Essence of methods, advantages and disadvantages, application.</p> <p>Quantitative photometric analysis. Conditions for photometric determination (selection of photometric reaction, analytical wavelength, solution concentration and absorbing layer thickness, use of reference solution).</p> <p>Determination of the concentration of the analyzed solution: calibration curve method, one standard method, determination of concentration by molar (or specific) extinction coefficient, standard addition method.</p> <p>Determination of the concentration of several substances in their joint presence.</p> <p>Differential photometric analysis. The essence of the method, methods for determining concentrations (calculation method, calibration curve method).</p> <p>Errors of spectrophotometric analysis, their nature, elimination.</p> <p>Extraction-photometric analysis. The essence of the method. conditions for the analysis. Photometric reactions in the extraction-photometric method. Application of the method.</p>

		<p>The concept of photometric titration.</p> <p><b>Luminescent analysis.</b>  The essence of the method. Classification of various types of luminescence. Fluorescence analysis. The nature of fluorescence. The main characteristics of luminescence: fluorescence spectrum, Stokes-Lommel law, Levshin's mirror symmetry rule, fluorescence quantum yield, law (rule) of S.I. Vavilov.</p> <p>Quantitative fluorescence analysis: principles of analysis, analysis conditions, luminescent reactions. Methods for determining the concentration of a substance (calibration curve method, single standard method). Application of fluorescent analysis.</p> <p><b>Extraction-fluorescence analysis.</b>  Titration with the use of fluorescent indicators.</p> <p>Chromatographic methods of analysis  Ion exchange chromatography. The essence of the method. Ionites. Ion exchange equilibrium, methods of ion exchange chromatography. Application of ion-exchange chromatography.</p> <p>Gas (gas-liquid and gas-adsorption) chromatography. The essence of the method. The concept of the theory of method. Retention parameters, separation parameters (degree of separation, separation factor, number of theoretical plates). Effect of temperature on separation. method practice. features of chromatography. Methods for quantitative processing of chromatograms (absolute calibration, internal normalization, internal standard). Application in pharmacy.</p> <p>The concept of combined methods: chromato-mass spectrometry, chromatophotometry.</p> <p>Liquid chromatography, high performance liquid chromatography. The essence of the method. Application of high performance liquid chromatography in pharmacy.</p> <p>capillary electrophoresis.</p> <p><b>Electrochemical methods of analysis</b>  General concepts. Classification of electrochemical methods of analysis. Methods without imposition and with imposition of external potential: direct and indirect electrochemical methods.</p> <p>Conductometric analysis (conductometry)  The principle of the method, basic concepts. Connection of concentrations of electrolyte solutions with their electrical conductivity.</p> <p>Direct conductometry. Determination of the concentration of the analyzed solution according to the measurement of electrical conductivity (calculation method, calibration curve method).</p> <p>Conductometric titration. The essence of the method. Types of conductometric titration curves.</p> <p>The concept of high-frequency conductometric titration.</p> <p>Potentiometric analysis (potentiometry). The principle of the method. Determination of the concentration of the analyzed solution in direct potentiometry (calibration curve</p>
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			<p>method, standard addition method). Application of direct potentiometry.</p> <p>Potentiometric titration. The essence of the method.</p> <p>Potentiometric titration curves (integral, differential).</p> <p>Application of potentiometric titration.</p> <p>Polarographic analysis (polarography)</p> <p>General concepts. The principle of the method.</p> <p>Polarographic curves, half-wave potential, relationship between the diffusion current and concentration.</p> <p>Quantitative polarographic analysis; determination of the concentration of the analyzed solution (calibration curve method, standard solution method). Conditions for conducting polarographic analysis. The use of polarography.</p> <p>Amperometric titration. The essence of the method. Terms of conduct. Amperometric titration curves. Application. The concept of amperometric titration with two indicator electrodes. electrochemical sensors.</p> <p>The concept of electrogravimetric analysis.</p> <p>Coulometric analysis. Method principles. Direct coulometry. The essence of direct coulometry at a constant potential. Methods for determining the amount of electricity passed through a solution in direct coulometry.</p> <p>coulometric titration. The essence of the method.</p> <p>Conditions for coulometric titration. Equivalence point indication. Application of coulometric titration.</p>
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## 5. Volume of the academic discipline and types of academic work

Type of educational work	Labor intensity		Labor intensity (AH) in semesters
	volume in credit units (CU)	volume in academic hours (AH)	
			1
<b>Classroom work, including</b>	<b>1,22</b>	<b>44</b>	<b>44</b>
Lectures (L)	0,28	10	10
Laboratory practicum (LP)*	-	-	-
Practicals (P)	0,94	34	34
<b>Student's individual work (SIW)</b>	<b>0,78</b>	<b>28</b>	<b>28</b>
Credit			Credit
<b>TOTAL LABOR INTENSITY</b>	<b>2</b>	<b>72</b>	<b>72</b>

## 6. Content of the academic discipline

### 6.1. Sections of the discipline and types of academic work:

№	№ semester	Name of the section of the academic discipline	Types of academic work* (in AH)				Evaluation tools
			L	LP	P	SIW	
1	4	Physical and chemical methods of analysis and their application	1	-	-	3	Multiply choice tests, tests or colloquia, survey, exam
2	4	Electrochemical methods of analysis	3	-	13	8	Multiply choice tests, tests or colloquia, laboratory works, survey, exam
3	4	Optical methods of analysis	3	-	11	8	Multiply choice tests, tests or colloquia, laboratory works, survey, exam
4	4	Chromatographic methods of analysis	3	-	10	9	Multiply choice tests, tests or colloquia, laboratory works, survey, exam
5	4	Credit					
		<b>TOTAL</b>	<b>10</b>	<b>-</b>	<b>34</b>	<b>28</b>	<b>72</b>

\* - L – lectures; LP – laboratory practicum; P – practicals; S – seminars; SIW – student's individual work.

### 6.2. Thematic schedule of educational work types:

#### 6.2.1 Thematic schedule of lectures

№	Name of lecture topics	Volume in AH
		semester 1
1.	General characteristics of instrumental methods of analysis. Classification of physical and chemical methods of analysis. Advantages and disadvantages. Choice for analysis.	1

2.	<p>Electrochemical methods of analysis. Conductometry. The principle of the method, basic concepts. Direct and indirect conductometry. High-frequency conductometric analysis.</p> <p>Potentiometry. The principle of the method. Types of electrodes in potentiometry. Direct potentiometry. Potentiometric titration. Application.</p> <p>Voltammetric method of analysis. Polarographic analysis. The principle of the method, application. polarographic curves.</p> <p>Quantitative polarographic analysis. Amperometric titration. The essence of the method, application. Amperometric titration curves.</p> <p>Electrogravimetric method of analysis. Coulometric analysis. Method principles. Direct coulometry. The essence of direct coulometry at a constant potential. Application of direct coulometry. coulometric titration. The essence of the method, application.</p>	2
		1
3.	<p>Optical methods of analysis. General principle of the method. Classification. Molecular spectral analysis in the ultraviolet and visible region of the spectrum. The essence of the method. Basic laws of light absorption. Electronic absorption spectra. Methods of absorption analysis. Quantitative photometric analysis.</p> <p>Differential photometric analysis. Errors of spectrophotometric analysis, their nature, elimination. Extraction-photometric analysis. Photometric titration. Luminescent analysis. Fluorescence analysis.</p>	2
		1
4.	<p>Chromatographic methods of analysis. Classification. Ion exchange chromatography. The essence of the method. Ionites. ion exchange equilibrium. The method of ion exchange chromatography. Application of ion-exchange chromatography.</p> <p>Absorption chromatography. Thin layer chromatography. The essence of the TLC method. Partition chromatography. Paper chromatography. Sieve and gel chromatography.</p> <p>Gas chromatography. The essence of the method. The concept of the theory of method. Retention options, separation options. Practice of the method, features of chromatography. Methods for quantitative processing of chromatograms.</p> <p>Liquid chromatography: high performance liquid chromatography. The essence of the method. Application of high performance liquid chromatography in pharmacy. The concept of combined methods: chromato-mass spectrometry, chromatosphotometry.</p>	1
		2
	TOTAL (10 AH)	10

### 6.2.2. The thematic plan of laboratory practicums

№	Name of laboratory practicums	Volume in AH
		Semester 1
1.	Electrochemical methods of analysis. Laboratory work. Direct potentiometry using ion-selective electrodes.	3
2.	Conductometry. Coulometry. Laboratory work. Conductometric titration of a mixture of strong and weak electrolytes.	3
3.	Voltammetry. Laboratory work. Potentiometric acid-base titration of acetylsalicylic acid. Potentiometric redox titration of	4

	ascorbic acid.	
4.	Photometric methods of analysis. Laboratory work. Determination of resorcinol content.	2
5.	Photometric methods of analysis. Laboratory work. Spectrophotometric determination of chromium and manganese in the joint presence.	3
6.	Photometric methods of analysis. Photometric titration. Laboratory work. Determination of copper content.	3
7.	Ion exchange chromatography. Laboratory work. Determination of the mass of copper salts.	3
8.	Chromatography on paper and in a thin layer. Laboratory work. Separation of halides by one-dimensional ascending TLC.	3
9.	Liquid and gas chromatography.	2
10.	SSW.	6
11.	Starting lesson.	2
	<b>TOTAL (total 34 AH)</b>	<b>34</b>

**6.2.3. Thematic plan of practicals:** not provided for.

**6.2.4. Thematic plan of seminars:** not provided for.

**6.2.5. Types and topics of student's individual work (SIW)**

№	Types and topics of SIW	Volume in AH
		Semester 1
1.	work with lecture material, providing for the development of lecture notes and educational literature, work with electronic literature;	5
2.	doing homework for class preparation for test;	5
3.	preparation of a report on practical work;	4
4.	writing an essay or research paper on a given problem.	14
	<b>TOTAL (total 144AH)</b>	<b>28</b>

**6.2.6. Student's research work:**

№	Student's research work:	Semester 1
1.	Methods for analyzing the quality of drugs.	4
2.	Modern physical and chemical methods in qualitative analysis.	
3.	The use of complex compounds.	
4.	Application of redox reactions in the analysis of substances.	
5.	Analysis of substances by chromatography.	
6.	Application of thin layer chromatography in the analysis of drugs.	
7.	Identification of thiols. Modern optical methods.	
8.	Photometry: qualitative and quantitative analysis.	
9.	Modern electrochemical methods of analysis.	
10.	Combined physical and chemical methods of analysis.	
11.	Acid-base titration method. Quantitative determination of medicinal substances.	
12.	Precipitation titration method. Quantitative determination of medicinal substances.	
13.	Conductometry. Application of the method in pharmacy.	
14.	Iometry. Application of the method in pharmacy.	
15.	Voltammetry. Practical application of the method.	

16	Luminescent analysis. Application of the method in pharmacy.	
17	Methods for separating mixtures of substances.	
18	Mass spectrometry.	
19	Chromatographic methods for the identification and determination of substances in a mixture.	
20	Methods of concentration of substances.	
21	Extraction in analytics.	
22	Application of organic reagents in analytical chemistry. Reactions based on the formation of complex compounds of metals.	
23	Application of organic reagents in analytical chemistry. Reactions without the participation of complex metal compounds.	

### 7. Types of assessment formats for ongoing monitoring and mid-term assessment

№	Semester No.	Types of control	Name of section of academic discipline	Competence codes		
					types	number of test questions
1.	1	Intermediate certification (test)	All sections.	Abstract protection		

### 8. Educational, methodological and informational support for mastering the academic discipline (printed, electronic publications, the Internet and other network resources)

#### 8.1. Key literature references

№	Name according to bibliographic requirements	Number of copies	
		at the department	at the department
1.	Watson, D. G. Pharmaceutical analysis : a textbook for pharmacy students and pharmaceutical chemists / D. G. Watson. – 5th ed. – Edinburgh : Elsevier, 2021. – VI, 462 p. : ill. – ISBN 978-0-7020-7808-8.	-	30
2.	Pedersen-Bjergaard S. Introduction to Pharmaceutical Analytical Chemistry / S. Pedersen-Bjergaard, B. Gammelgaard, T. G. Halvorsen. – 2nd ed. – [S. I.] : Wiley, 2019. – XXIII, 520 p. – ISBN 978-1-119-36272-2.	-	30
3.	Pharmaceutical Analysis for Small Molecules / ed. B. Davani. – [S. I.] : Wiley, 2017. – XXV, 229 p. – ISBN 978-1-119-12111-4.	-	2

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## 8.2. Further reading:

### 8.3. Electronic educational resources for teaching academic subjects

#### 8.3.1. Internal Electronic Library System of the University (IELSU)

<i>№</i>	<i>Name of the electronic resource</i>	<i>Brief description (content)</i>	<i>Access conditions</i>	<i>Number of users</i>

#### 8.3.2. Electronic educational resources acquired by the University

<i>№</i>	<i>Name of the electronic resource</i>	<i>Brief description (content)</i>	<i>Access conditions</i>	<i>Number of users</i>
1.	International scientometric database "Web of Science Core Collection"	Web of Science covers materials on natural, technical, social, humanities; takes into account the mutual citation of publications developed and provided by Thomson Reuters; has built-in search, analysis and management of bibliographic information.	Free access from PIMU computers [Electronic resource] - Access to the resource at: <a href="http://apps.webofknowledge.com">http://apps.webofknowledge.com</a>	Free access from PIMU computers

#### 8.3.3 Open access resources

<i>№</i>	<i>Name of the electronic resource</i>	<i>Brief description (content)</i>	<i>Access conditions</i>
1.	Federal Electronic Medical Library (FEMB)	Includes electronic analogues of printed publications and original electronic publications that have no analogues recorded on other media (dissertations, abstracts, books, magazines, etc.). [Electronic resource] – Access mode: <a href="http://femb.pfl/">http://femb.pfl/</a>	from any computer on the Internet
2.	Scientific electronic library eLIBRARY.RU	The largest Russian information portal in the	from any computer on the Internet

		field of science, technology, medicine and education, containing abstracts and full texts of scientific articles and publications. [Electronic resource] - Access mode: <a href="https://elibrary.ru/">https://elibrary.ru/</a>	
3.	Scientific electronic library of open access CyberLeninka	Full texts of scientific articles with annotations published in scientific journals in Russia and neighboring countries. [Electronic resource] - Access mode: <a href="https://cyberleninka.ru/">https://cyberleninka.ru/</a>	from any computer on the Internet

## **9. Material and technical support for mastering an academic discipline**

### 9.1. List of premises for classroom activities for the discipline

1. *Lecture hall equipped with multimedia equipment and a microphone.*
2. *Rooms for laboratory workshops.*

### 9.2. List of equipment for classroom activities for the discipline

1. Multimedia complex (computer and projection equipment)
2. Information stands.
3. Tables and directories.
4. Slides and multimedia presentations of lectures.
5. Chemical glassware (burettes, pipettes, flasks, glass slides; chemical reagents).
6. Chemical reagents.
7. Hood.
8. Microscopes.
9. Spirit lamps.
10. Electric stoves.
11. Analytical balance.
12. Ionomers with a set of electrodes.
13. Photoelectrocolorimeters, spectrophotometers.
14. Centrifuge.
15. Water bath.
16. Test tube racks.
17. Reagent racks.
18. Magnetic stirrers.
19. Conductometer.

20. Chromatographic chamber.

9.3. A set of licensed and freely distributed software, including domestic production

Item no.	Software	number of licenses	Type of software	Manufacturer	Number in the unified register of Russian software	Contract No. and date
1	Wtware	100	Thin Client Operating System	Kovalev Andrey Alexandrovich	1960	2471/05-18 from 28.05.2018
2	MyOffice is Standard. A corporate user license for educational organizations, with no expiration date, with the right to receive updates for 1 year.	220	Office Application	LLC "NEW CLOUD TECHNOLOGIES"	283	without limitation, with the right to receive updates for 1 year.
3	LibreOffice		Office Application	The Document Foundation	Freely distributed software	
4	Windows 10 Education	700	Operating systems	Microsoft	Azure Dev Tools for Teaching Subscription	
5	Yandex. Browser		Browser	«Yandex»	3722	
6	Subscription to MS Office Pro for 170 PCs for FGBOU VO "PIMU" of the Ministry of Health of Russia	170	Office Application	Microsoft		23618/HN10 030 LLC "Softline Trade" from 04.12.2020



## 10. List of changes to the working program (to be filled out by the template)

Position	Number and name of the program section	Contents of the changes made	Effective date of the changes	Contributor's signature
1				

Federal State Budgetary Educational Institution of Higher Education  
"Privolzhsky Research Medical University"  
Ministry of Health of the Russian Federation  
(FSBEI HE "PRMU" of the Ministry of Health of Russia)

Department of  
*General Chemistry*

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### CHANGE REGISTRATION SHEET

working program for the academic discipline  
«**INSTRUMENTAL METHODS IN ANALYTICAL CHEMISTRY**» (elective subject)

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Field of study / specialty / scientific specialty: 31.05.01 "**GENERAL MEDICINE**"

Training profile: **GENERAL PRACTITIONER**

Mode of study: Full-time

Approved at the department meeting  
Protocol No. 1, of August 26, 2020

Head of the Department  
of General Chemistry,  
Doctor of Chemistry, Professor Gordetsov A.S

/Gordetsov A.S./