MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION
Federal State Autonomous Educational Institution of Higher Education
Far Eastern Federal University
(FEFU)
INSTITUTE OF LIFE SCIENCES AND BIOMEDICINE (SCHOOL)

AGREED	CLAIM
Head of Educational Program	Director of the Production Company Structural subdivision
_____ V.V. Kumeiko	_____ V.V. Kumeiko
(Signed) (Surname)	(Signed) (Surname)
	April 12, 2023

WORK PROGRAM OF THE DISCIPLINE
Programming in Biomedicine
Area of study 06.03.01 Biology
Form of training: full-time

The work program is drawn up in accordance with the requirements of the Federal State Educational Standard in the field of training 06.03.01 Biology, approved by the order of the Ministry of Education and Science of Russia dated 07.08.2020 No. 920

The work program was discussed at the meeting of the Department of Medical Biology and Biotechnology, Minutes No. 3 dated April 12, 2023.

Director of the Department of Medical Biology and Biotechnology V.V. Kumeiko

Compiled by: Ph.D. Kumeiko V.V.

Vladivostok
2022

Back of the title page of the RPD

1. *The work program was revised at the meeting of the Department/Department/Division (implementing the discipline) and approved at the meeting of the Department/Department/Division (graduating structural unit), minutes of "*
   _____ *202 No.*
2. *The work program was revised at the meeting of the Department/Department/Division (implementing the discipline) and approved at the meeting of the Department/Department/Division (graduating structural unit), minutes of "*
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   _____ *202 No.*

Abstract of the discipline

Programming in Biomedicine

The total labor intensity of the discipline is 4 credit units / 144 academic hours. The curriculum provides for 18 hours of lectures, *18* hours of practical work, *54* hours of practical work, and *72 hours* of independent work for the student.

Language: Russian.

Objective: To form a comprehensive system understanding of molecular modeling of biomolecules and the applied aspects of using this technology to solve professional problems.

Tasks:

- formation of ideas about the main algorithms ofchemical agents used in molecular modeling;
- acquaintance with the main methods of computer modeling of the spatial structure of molecules and approaches to their solution;
- Familiarity with the main methods of virtual screening of databases of chemical compounds;
- Formation of ideas about the basic techniques of computer design of target-oriented complexes.

For successful study of the discipline, students should have the following preliminary competencies:

•searches and collects information using computer technologies;

- develops information products for processing and analyzing information, following the principles of critical assessment and verification of sources;
- usesdigital tools to organize their work and self-development.

Competencies were obtained as a result of studying the disciplines of *bioinformatics*, *digitaltechnologies in professional activities, biostatistics*.

Students' Competencies, Indicators of Their Achievement and Learning Outcomes in the Discipline

Code and name of the competency (result of mastering)	Code and name of the competency indicator
PC-5 Able to build mathematical models of physical, chemical and biological processes to solve biomedical problems, possess basic programming skills, use modern methods and resources of bioinformatics and biostatistics	PC-5.1 Able to build mathematical models of physical processes of living organisms, set parameters and simulate physical problems in common programming languages, including Python
	PC-5.2 Able to build mathematical models of chemical processes to solve biomedical problems, set parameters and model chemical problems in common programming languages, including Python
	PC-5.3 Able to build mathematical models of biological processes, set parameters and simulate biological problems in

	common programming languages, including Python
	PC-5.4 Applies modern information technologies and software tools in solving professional problems

Code and name of the competency indicator	Name of the assessment indicator (the result of learning in the discipline)
PC-5.1 Able to build mathematical models of physical processes of living organisms, set parameters and simulate physical problems in common programming languages, including Python	Knows Mathematical Models of Physical Processes of Living Organisms. Can build mathematical models of physical processes of living organisms, set parameters and conduct modeling. Owns skills in creating mathematical models of physical processes of living organisms, setting parameters and modeling physical problems in common programming languages, including Python
PC-5.2 Able to build mathematical models of chemical processes to solve biomedical problems, set parameters and model chemical problems in common programming languages, including Python	Knows Mathematical Models of Chemical Processes for Solving Biomedical Problems. Can build mathematical models of chemical processes to solve biomedical problems, set parameters and simulate chemical problems in common programming languages, including Python. Owns skills in building mathematical models of chemical processes to solve biomedical problems, setting parameters and modeling chemical problems in common programming languages, including Python.
PC-5.3 Able to build mathematical models of biological processes, set parameters and simulate biological problems in common programming languages, including Python	Knows Mathematical Models of Biological Processes. Can build mathematical models of biological processes, set parameters and simulate biological problems in common programming languages, including Python. Owns skills in building mathematical models of biological processes, setting parameters and modeling biological tasks in common programming languages, including Python.
PC-5.4 Applies modern information technologies and software tools in solving professional problems	Knows modern information technologies and software tools for solving professional problems. Can apply modern information technologies and software tools in solving professional problems. Owns skills in the use of modern information technologies and software tools in solving professional problems.

To form the above competencies within the discipline "Programming in Biomedicine", the following educational technologies and methods of active/interactive learning are used: a business game, work in small groups, a round table.

I. Goals and objectives of mastering the discipline

Objective: To form a comprehensive system understanding of molecular modeling of biomolecules and the applied aspects of using this technology to solve professional problems.

Tasks:

- formation of ideas about the main algorithms ofchemical agents used in molecular modeling;
- acquaintance with the main methods of computer modeling of the spatial structure of molecules and approaches to their solution;
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Students' Competencies, Indicators of Their Achievement and Learning Outcomes in the Discipline

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Code and name of the competency indicator	Name of the assessment indicator (the result of learning in the discipline)
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PC-5.4 Applies modern information technologies and software tools in solving professional problems	Knows modern information technologies and software tools for solving professional problems. Can apply modern information technologies and software tools in solving professional problems. Owns skills in the use of modern information technologies and software tools in solving professional problems.

II. Labor intensity of the discipline and types of training in the discipline

The total labor intensity of the discipline is 4 credit units (144 academic hours).

Types of training sessions and work of a student in the discipline can be:

Designation	Types of Study Sessions and Student Work
Mild	Lecture
Ave	Practical exercises
WED	Student's independent work during the period of theoretical training
Control	Independent work of the student and contact work of the student with the teacher during the period of intermediate certification

III. Structure of the discipline

The form of study is full-time.

№	Section Name Discipline	Semester	Number of hours by type of training and work of the student						Forms of intermediate attestation
			Mild	Lab	Ave	OK	WED	Control	
1	Fundamentals of Computer Modeling of Biomolecules. Application of Computer Technologies in Bioorganic Chemistry and Biotechnology	6	6	-	18	-	45	27	Exam Questions
2	Features of modeling the structure of proteins. Features of the structure and classification of proteins. Databases on the 3D structure of proteins		6		18				Exam Questions
3	Study of the 3D structure of biomolecule complexes and the application of modeling to solve biotechnology problems. Modeling of protein-ligand and protein-protein complexes		6		18				Exam Questions
	Total:	6	18	-	54	-	45	27	exam

IV. THE CONTENT OF THE THEORETICAL PART OF THE COURSE

Lecture

Section I. Fundamentals of Computer Modeling of Biomolecules. Application of Computer Technologies in Bioorganic Chemistry and Biotechnology.

Topic 1. Basics of Computer Representation of the Structure of Biomolecules and History of Molecular Visualization

Historical Significance of Methods for Deciphering Biopolymer Sequences. Determination of spatial structures of biomolecules by X-ray crystallography and NMR spectroscopy (RCSB PDB). High-resolution cryo-electron microscopy for visualization of biomolecules (Nobel Prize in Chemistry 2017).

Topic 2. Up-to-date databases on the structure of biomolecules

Database - functions and classification. Overview of the main databases. Primary databases. Nucleic acid sequence databases. EMBL (European Molecular Biology Laboratory). DDBJ (DNADataBank of). GenBank. GSDB (Genome Sequence DataBase). Ensemble. JapanSpecialized databases: SGD (Saccharomyces Genome Database), TDB (TIGR DataBase), 7EST. Secondary databases. *PROSITE. PRINTS.*

BLOCKS. IDENTIFY. KEGG (KyotoEncyclopedia of Genes and Genomes). Bibliographic databases. *PubMed.AGRICOLA* (Agricultural Online Access). Virtual Library. Specialized database analysis tools. GCG (Genetics Computer Group) package. EGCG. Staden. Lasergene. Sequencher. Vector, NTI. MacVector. SYNERGY. PangeaSystem.EMBOSS. Alfresco. DALI (Distance matrix Alignment). Current trends in database structuring. Uniprot-Swiss-Prot database. Protein sequence databases. PIR (International Protein SequenceDatabase). SWISS-PROT. TrEMBL (TRanslated from EMBL). Protein Research Foundation.Structure databases. PDB (Protein data base). MSD (Macromolecular Structure Database). SCOP (Structure classification of Protein). SATN (Class / Architecture / Topology /Homology). NDB **(**Nucleic Acid Database), CSD (Structural Database). BMRB(BioMagResBank). FSSP (Fold classification based on Structure-Structure alignment of Proteins).Cambridge

Section II: Features of **Protein Structure Modeling. Features of the structure and classification of proteins. Databases on the 3D structure of proteins.**

Topic 1. Prediction of the spatial structure of a protein based on the amino acid sequence by the method of comparative modeling. State-of-the-art Internet servers for modeling the3D structure of proteins

Homologous Modeling of Protein Structures – Relevance and Examples of Model Protein Structures. Data banks of PDB and UNIPROT protein structures and sequences and the information contained in these banks. Experimental methods for deciphering protein structures include X-ray diffraction analysis, multidimensional nuclear magnetic resonance, and low-temperature electron microscopy. Structurally conserved regions in the structure of proteins and methods for their determination.

Topic 2. Optimization of the3D structure of biomolecules by molecular dynamics

Use of computational packages of molecular dynamics in full-atomic resolution (CHARM, NAMD, Gromacs) to study the behavior of biomolecules at the submolecular level.

Section III. Study of the **3D structure of biomolecule complexes and the application of modeling to solve biotechnology problems. Modeling of protein-ligand and protein-protein complexes**

Topic 1. Molecular docking with "rigid" and "mobile" ligand

Molecular docking (applications)Actual modeling of a specific complex.Determination of the functional features of the target surface (for example: the position of the binding site) and the features of the interaction of molecules in the complex. Search for ligands for a specific target among a large number of molecules (The inverse problem is to exclude a

molecule from the list of possible ligands). Create previously non-existent ligands for a specific target. Obtaining natural alignment of ligands.

Topic 2. Molecular docking for the search for viral protein inhibitors

Artificial peptides that can neutralize influenza viruses by interacting with hemagglutinins. Development of technologies for the design of new antiviral drugs based on modeling the processes of interaction between the virus and the host cell at the level of protein-membrane interactions.

Topic 3. Modeling of oligomeric protein complexes. Molecular docking for the search for ion channel inhibitors

The relationship between the spatial organization of protein complexes and the molecular mechanisms of various biological processes. Calcium channel inhibitors as a drug in the treatment of cardiovascular diseases.

V. CONTENT OF THE PRACTICAL PART OF THE COURSE AND INDEPENDENT WORK

Practical exercises

Class 1. Examples of the use of computer modeling methods in bioorganic chemistry. Introduction and training in molecular editors (RASMOL, VEGA ZZ, SPDBV) for visualizing the structure of molecules

1. Familiarity with file formats for describing the structure of molecules, ways to visualize the structure of molecules, and calculation of the physicochemical properties of molecules.
2. Internet servers for modeling the structure of molecules and databases on the structure of small and high molecular weight compounds.

Class 2. Working with modern databases on the structure of molecules: NCBI, PDB, PubChem, CCDC

1. Sequence alignment with BLAST. Identification of protein sequences by alignment with a full-structure protein.
2. Use of information from the http://www.ncbi.nlm.nih.gov/blast/bl2seq/wblast2.cgi site (web-interface to the program "bl2seq") to determine the coordinates of an unknown sequence in the sequence of a full-structure protein. Save the local similarity map as a gif file.

Class 3. Fundamentals of the Method of Comparative Modeling of the Structure of Proteins by Their Amino Acid Sequence. Modeling the Structure of Viral Proteins and Ion Channels

1. Recognition of the fold (folding method) of a protein molecule using libraries of known folds.

2. Modeling the structure of influenza virus (HA) hemagglutinin using a "virtual library" of amino acid sequences. Constructing a model of an ion potassium channel.

Class 4. Molecular docking of protein-ligand and protein-protein. Docking of viral target proteins with low molecular weight ligands to search for potential inhibitors

1. Preparation of the protein sequence for docking. Limitations of the molecular docking method.
2. Calculation of the ligand-protein binding strength (function). Consideration of the flexibility of the low-molecular-weight ligand and the influence of the microenvironment environment of the active binding site.

Class 5. Molecular docking of ion channels with peptides to search for potential modulators and inhibitors

1. Positioning of the inhibitor at the active site of the ion channel and calculation of the inhibitor-protein binding constant.
2. Algorithms for finding the global minimum of the binding energy function.

Class 6. Optimization and Analysis of the Structure of Complexes Using High-Performance Computing

1. High-performance computing based on statistical information obtained from three-dimensional structures of complexes of proteins with ligands.
2. A "virtual screening" method to optimize the number of ligands that have an affinity for the protein being studied.

Self-paced work

Methodical Instructions for Preparation for Performing Tasks in Practical Work and Drawing Up Reports on the Work Done

Quizzes for self-study for practical work

1. Where is information about gene and protein sequences stored, and in what format?
2. What is the format of records in Protein Data Bank?
3. Tools for extracting information from bioinformatics databases?
4. What information does OMIM store?
5. How can I find information about amino acid substitutions associated with the development of diseases?

6. The Role of Computational Experiments in Postgenomic Biology and Medicine
7. Methods for Modeling the Structure of Biological Macromolecules
8. Biochemical Pathway Modeling Methods.
9. Modeling of molecular dynamics, ideological foundations and possibilities of computer implementation.
10. Functional Appearance and Physical Nature of Molecular Interaction Potentials. General scheme of a molecular-dynamic computational experiment.
11. Molecular dynamics of proteins.
12. Examples: Setting up computational experiments.
13. Visualization of molecular dynamics trajectories.
14. Simulation of the force unfolding of a protein globule.
15. What ideas underlie the modeling of thermal mobility of atomic systems by molecular dynamics?
16. When and for which molecular systems were the first computational experiments using the method of molecular dynamics carried out?
17. What are the most common software packages for modeling the molecular dynamics of biomolecular systems?
18. What are the characteristic values of the spatial, temporal, and energetic scales that arise in the description of molecular systems?

Structure of Written Reports on Practical Work

Work reports are submitted in electronic form, prepared as text documents in the MSWord editor.

The report on the work should be a summarizing document, include all information on the implementation of tasks, including a list of references and analysis of this scientific literature, own conclusions, etc.

Structurally, the report, as a text document, is completed according to the following scheme:

- *The title page* is *an obligatory* component of the report, the first page of the report;
- *Initial data for the execution of tasks* – a mandatory component of the report, from a new page, contain an indication, etc.);
- *The main part, the materials of the* tasks, are divided into headings corresponding to the tasks of the work, with a hierarchical structure: items – sub-items, etc.

It is recommended to give headings of rubrics (subheadings) in the main part of the report based on the wording of the tasks in the form of verbal nouns;

- *Conclusions* – an obligatory component of the report, contains summarizing conclusions on the work;

- *The list of scientific literature is* an obligatory component of the report, from a new page, it contains a list of sources used in the work, including electronic sources (the list is numbered, in accordance with the rules for describing the bibliography according to GOST 7.32-2001).

Preparation of written reports

It is necessary to pay attention to the following aspects in the preparation of written reports:

- typing;
- structuring of work;
- design of headings of all types (headings-subheadings-paragraphs-subparagraphs, figures, tables, annexes);
- registration of transfers (lists with numbering or marking);
- table formatting;
- design of illustrations (graphs, drawings, photographs, schemes);
- set and design of mathematical expressions (formulas);
- preparation of bibliography (bibliographic = descriptions) and references to citation sources.

Typing is carried out on a computer, in accordance with the following requirements:

- printing – on one side of a sheet of white A4 paper (size 210 per day.)297 мм;
- line spacing – one and a half;
- font – Times New Roman;
- Font size - 14 pt., including in headings (10-12 pt.);
- Text alignment – "justified";
- - The margins of the page are left – 25-.30 мм, right – .10 мм, upper and lower – .20 мм;
- Page numbering is in the lower right corner of the page (for pages with portrait orientation), consecutive, from the title page to the last page, in Arabic numerals (the first page is considered to be the title page, on which the number is not placed, on the next page the number "2" is put, etc.).
- Automatic word wrapping mode, except for the title page and headings of all levels (word wrapping for a separate paragraph is blocked by MSWord using the "Format" – paragraph command when the "Disable automatic word hyphenation" option is selected).

If a figure or table is placed on a sheet larger than A4, it should be counted as one page. In these cases, it is allowed not to indicate the page number.

Criteria for evaluating the performance of independent work.

Evaluation of independent works is carried out according to the following criteria.

Completeness and quality of completed tasks;

• Theoretical substantiation of the obtained result;

Quality of the report, use of rules and standards for the design of text and electronic documents;

No factual errors related to the understanding of the topic.

The following is also evaluated.

The goals and objectives of the work have been determined;

The method and means of carrying out the work have been chosen;

The structure of the work has been determined;

Demonstration material has been thought out and tested;

The document is properly executed.

VI. MONITORING THE ACHIEVEMENT OF THE COURSE OBJECTIVES

Item No.	Supervised sections/topics of the discipline	Code and name of the indicator of achievement	Learning Outcomes	Evaluation Tools	
				Current control	Intermediate Certification
1	Fundamentals of Computer Modeling of Biomolecules. Application of Computer Technologies in Bioorganic Chemistry and Biotechnology	PC-5.1 Able to build mathematical models of physical processes of living organisms, set parameters and simulate physical problems in common programming languages, including Python	Knows Mathematical Models of Physical Processes of Living Organisms. Can build mathematical models of physical processes of living organisms, set parameters and conduct modeling. Owns skills in creating mathematical models of physical processes of living organisms, setting parameters and modeling physical problems in common programming languages, including Python	Colloquium	Exam Questions
2	Features of modeling the structure of proteins. Features of the structure and classification of proteins. Databases on the 3D structure of proteins	PC-5.2 Able to build mathematical models of chemical processes to solve biomedical problems, set parameters and model chemical problems in common programming languages, including Python	Knows Mathematical Models of Chemical Processes for Solving Biomedical Problems. Can build mathematical models of chemical processes to solve biomedical problems, set parameters and simulate chemical problems in common programming languages, including Python. Owns skills in building mathematical models of chemical processes to solve biomedical problems, setting parameters and modeling chemical problems in common programming languages, including Python.	Oral Questioning	

3	Study of the 3D structure of biomolecule complexes and the application of modeling to solve biotechnology problems. Modeling of protein-ligand and protein-protein complexes	PC-5.3 Able to build mathematical models of biological processes, set parameters and simulate biological problems in common programming languages, including Python	Knows Mathematical Models of Biological Processes. Can build mathematical models of biological processes, set parameters and simulate biological problems in common programming languages, including Python. Owns skills in building mathematical models of biological processes, setting parameters and modeling biological tasks in common programming languages, including Python.	Oral Questioning	
		PC-5.4 Applies modern information technologies and software tools in solving professional problems	Knows modern information technologies and software tools for solving professional problems. Can apply modern information technologies and software tools in solving professional problems. Owns skills in the use of modern information technologies and software tools in solving professional problems.	Colloquium	

VII. EDUCATIONAL AND METHODOLOGICAL SUPPORT OF STUDENTS' INDEPENDENT WORK

Guidelines for writing and formatting an abstract

Abstracting of educational and scientific literature involves an in-depth study of individual scientific works, which should ensure the development of the necessary skills for working on the book. All this will contribute to the expansion of scientific horizons, the improvement of their theoretical training, and the formation of scientific competence.

Textbooks, individual monographic studies and articles on issues provided for by the program of the academic discipline are offered for abstracting. When selecting literature on the chosen issue, it is necessary to cover the most important areas of development of this science at the present stage. Particular attention should be paid to those literary sources that (directly or indirectly) can help the specialist in his practical activities. However, this section also includes works and individual studies on issues that go beyond the discipline being studied. It is recommended to use this literature if you want to expand your knowledge in any branch of science.

Along with literature on general issues, students are supposed to read literature taking into account the profile of their professional activity, obtained independently. Not all the proposed literature is equal in content and volume, so different approaches to its study are possible. In one case, it can be a general abstract of several literary sources of different authors devoted to the consideration of the same issue, in the other case, it can be a detailed study and abstract of one of the recommended works or even its separate sections, depending on the degree of complexity of the issue (problematic). In order to decide what to do in each case, you should consult with the teacher.

The choice of a specific work for the abstract should be preceded by a detailed acquaintance with the list of all literature given in the curriculum of the discipline. It is recommended to first familiarize yourself with the selected work by looking at the subheadings, highlighted texts, diagrams, tables, and general conclusions. Then it is necessary to read it carefully and thoughtfully (delving into the ideas and methods of the author), making notes on a separate sheet of paper about the main provisions and key issues. After reading, you should think over the content of the article or a separate chapter, paragraph (if we are talking about a monograph) and briefly write it down. Only strict definitions and formulations of laws should be written out verbatim. Sometimes it's helpful to include one or two examples to illustrate. In the event that there are unclear passages, it is recommended to read the following exposition, as it can help to understand the previous material, and then return to the comprehension of the previous exposition.

The result of the work on literary sources is an abstract.

When preparing an abstract, it is necessary to highlight the most important theoretical provisions and substantiate them independently, paying attention not only to the result, but also to the methodology used in the study of the problem. Reading scientific literature should be critical. Therefore, it is necessary to strive not only to assimilate the main content, but also the method of proof, to reveal the features of different points of view on the same issue, to assess the practical and theoretical significance of the results of the reviewed work. A very desirable element of the abstract is the expression by the listener of his own attitude to the ideas and conclusions of the author, supported by certain arguments (personal experience, statements of other researchers, etc.).

As mentioned above, abstracts of monographs and journal articles of a research nature must contain a definition of the problem and specific objectives of the research, a description of the methods used by the author, as well as the conclusions that he came to as a result of the research. The proposed literature for abstracting is constantly updated.

Instructions for writing essays:

General requirements for the abstract:

The abstract should be written according to the standard scheme, including:

- Title page
-contents
-introduction
- Main part
- Conclusionof the E
- List of references.

It is desirable to include tables and (or) figures in the text of the abstract: diagrams, graphs.The volume of the abstract: 10-20 pages of A4 format computer layout in the Times New Roman editor, with 1.5 intervals, in 14 fonts. The title of the topic of the essay should fully correspond to the chosen option.

The structure of the abstract should meet the standard requirements for writing essays: introduction, justification for the choice of topic, presentation of the topic, conclusion. More detailed requirements for the written design of the abstract are presented in the Procedure "Requirements for the design of written works performed by FEFU students and attendees" http://law.wl.dvgu.ru/docs/treb_2012.pdf

Approximate list of abstract topics:

1. Mechanisms of energy production in mitochondria.
2. The liver is its role for the human body.
3. Alcoholism and drug addiction are metabolic disorders.
4. Influence of trace elements on enzyme activity.
5. Metabolic connections of the Krebs cycle.
6. Types of jaundice.

7. Biotransformation of xenobiotics in the body.
8. Cholesterol fund in the human body and ways of its consumption.
9. Biological role of iron, molybdenum and zinc.

Criteria and Indicators Used in the Evaluation of the Educational Essay

Criteria	Indicators
1. Novelty of the abstracted text Max. - 5 points	- relevance of the problem and topic;- novelty and independence in the formulation of the problem, in the formulation of a new aspect of the problem selected for analysis;- the presence of the author's position, independence of judgments.
2. Degree of disclosure of the essence of the problemMax. - 5 points	- correspondence of the plan to the topic of the abstract;- correspondence of the content to the topic and plan of the abstract;- completeness and depth of disclosure of the main concepts of the problem;- validity of ways and methods of working with the material;- ability to work with literature, systematize and structure the material;- ability to generalize, compare different points of view on the issue under consideration, argue the main provisions and conclusions.
3. Reasonableness of the choice of sourcesMax. - 5 points	- the range and completeness of the use of literary sources on the problem;- attraction of the latest works on the problem (journal publications, materials of collections of scientific papers, etc.).
4. Compliance with Registration Requirements Max. – 5 points	- correct formatting of references to the literature used;- literacy and culture of presentation;- knowledge of terminology and conceptual apparatus of the problem;- compliance with the requirements for the volume of the abstract;- culture of design: highlighting paragraphs.
5. Literacy Max. - 5 points	- absence of spelling and syntax errors, stylistic errors;- absence of typos, abbreviations of words, except for generally accepted ones;- literary style.

Guidelines for Maintenance, Submission Requirements and Criteria for Evaluating the Outline

A synopsis (from the Latin conspectus – review) is a written text in which the content of the main source of information is briefly and consistently stated. To take notes is to bring to some order the information gleaned from the original. The process is based on the systematization of what has been read or heard. Notes can be made both in the form of precise excerpts, quotations, and in the form of a free presentation of meaning. The manner of writing the synopsis, as a rule, is close to the style of the original source. If the synopsis is written correctly, it should reflect the logic and semantic connection of the information being recorded.

In well-made notes, it is easy to find specialized terminology that is clearly explained and clearly highlighted for memorizing the meanings of various words. Using the outline information, it is easier to create meaningful creative or scientific works, various essays and articles.

Note-taking rules

1. Read the text carefully. Along the way, mark incomprehensible places, new words, names, dates.

2. Make inquiries about the persons and events mentioned in the text. When recording, do not forget to put reference data in the fields.

3. When reading the text for the first time, make a simple outline. When re-reading, try to summarize the main points of the text, noting the author's arguments.

4. The final stage of note-taking consists of re-reading the previously marked passages and writing them down consecutively.

5. When taking notes, you should try to express the author's thought in your own words.

6. Strive to ensure that one paragraph of the author's text is conveyed in one, maximum two sentences.

When taking notes of lectures, it is recommended to adhere to the following basic rules.

1. Do not start writing down the material from the first words of the teacher, first listen to his thought to the end and try to understand it.

2. Start writing at the moment when the teacher, having finished the presentation of one idea, begins to comment on it.

3. In the synopsis, it is necessary to highlight individual parts. It is necessary to distinguish between headings, subheadings, conclusions, to separate one topic from another. Selection can be done with an underline or a different color (just don't turn the text into colorful pictures). It is recommended to indent paragraphs and points of the plan, white lines to separate one thought from another, and numbering. If definitions, formulas, rules, and laws can be made more visible in the text, they are framed. Over time, you'll have your own selection system.

4.Create your entries using accepted conventions. When taking notes, be sure to use a variety of signs (they are called signal signs). These can be pointers and directional arrows, exclamation and question marks, combinations PS (afterword) and NB (pay attention). For example, you can denote the word "therefore" with a mathematical arrow =>. Once you've developed your own character set, it's easier and faster to create an outline and then study it.

5. Don't forget about abbreviations (abbreviated words), equal and inequality signs, more and less.

6. Abbreviations are very useful for creating a correct outline. Be careful, though. Connoisseurs believe that abbreviations such as "d-t" (to think) and similar ones should not be used, since later a large amount of time is spent on deciphering, and after all, the reading of the synopsis should not be interrupted by extraneous actions and reflections. The best thing to do is to develop your own system of abbreviations and use them to denote the same words (and nothing else) in all entries. For example, the abbreviation

"g-t" will always and everywhere be the word "to speak," and the capital "P" will be the word "work."

7. Undoubtedly, foreign words will help to organize a good synopsis. The most common among them are English. For example, the abbreviated "ok" successfully denotes the words "excellent", "wonderful", "good".

8. Complex and lengthy reasoning should be avoided.

9. When taking notes, it is better to use declarative sentences, avoid independent questions. Questions are appropriate in the margins of the outline.

10. Do not try to record the material verbatim, in this case the main idea is often lost, and it is difficult to keep such a record. Discard secondary words, without which the main idea is not lost.

11. If there are terms in the lecture that you do not understand, leave a place, clarify their meaning with the teacher after the lesson.

Evaluation criteria:

86-100 points are given to the student if the abstract is presented in the most understandable form, has a plan, schemes and drawings in the structure, reveals all the basic concepts and questions given above;

76-85 points are given to the student if the abstract is presented in a sufficiently understandable form, has schemes and/or drawings in the structure, reveals more than half of the main concepts and questions;

75-61 points are given to the student if the abstract is presented in a relatively understandable form and reveals half of the main concepts and questions;

60-50 points are given to the student if the outline is presented in an incomprehensible form and reveals less than half of the main concepts and questions.

VIII. LIST OF EDUCATIONAL LITERATURE AND INFORMATIONAL AND METHODOLOGICAL SUPPORT OF THE DISCIPLINE

Reference citations

1. Efremov G. I. Modelirovanie khimiko-tekhnologicheskikh protsessov: uchebnik [Modeling of chemical and technological processes: textbook]. - 2nd ed., ispr. Moscow: INFRA-M, 2021. — 260 p. + Add. materials [Elektronnyi resurs]. — (Higher education: Bachelor's degree). — DOI 10.12737/1090526. - ISBN 978-5-16-016255-3. - Text : electronic. - URL: https://znanium.com/catalog/product/1090526

2. Astrakhantseva I. A., Bobkov S. P. Modelirovanie sistem : uchebnoe posobie [Modeling of systems: textbook]. Moscow: INFRA-M, 2023. — 216 p. — (Higher education: Bachelor's degree). — DOI 10.12737/1831624. - ISBN 978-5-16-017220-0. - Text : electronic. - URL: https://znanium.com/catalog/product/1831624

3. Kadantsev, V. N. Biophysical Foundations of Interaction of Living Systems: Textbook for Secondary Professional Education / V. N. Kadantsev. - Moscow: Yurayt Publishing House, 2023. — 206 p. — (Professional education). — ISBN 978-5-534-15841-0. — Text : electronic // Educational platform Urait [site]. — URL: https://urait.ru/bcode/509855

4. The Use of the ChemCraft Software Package for Modeling and Visualization of the Structure and Properties of Molecular Systems: Methodological Instructions / compiled by T. N. Grishaeva, A. N. Masliy, A. M. Kuznetsov, edited by S. V. Borisevich. - Kazan: Kazan National Research Technological University, 2016. — 56 p. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: https://www.iprbookshop.ru/61971.html

Further reading

1. Blinov V. I., Vinenko V. G., Sergeev I. S. Metodika prepodavavaniya v vysshei shkole: uchebrakticheskoe posobie dlya vuzov po gumanitarnym napravleniya i spetsial'nosti [Methods of teaching in higher school: a practical manual for higher education institutions in humanitarian areas and specialties]. - M. : Yurayt. Moscow State Pedagogical University, 2015. – 315 p. (3 copies) https://lib.dvfu.ru:8443/lib/item?id=chamo:785120&theme=FEFU

2. Borovkova T.I. Tekhnologii otkrytykh obrazovaniya [Technologies of open education]: Textbook / T.I. Borovkova. Moscow: InfraM; Znanium.com, 2015. – 173 p. – Mode of access: http://znanium.com/go.php?id=504867

3. Knorre D.G., Godovikova T.S., Myzina S.D. [and others]. - Novosibirsk: Novosibirsk University, 2011. – 480 p. http://lib.dvfu.ru:8080/lib/item?id=chamo:679690&theme=FEFU

4. Heltier, H.-D. Molecular Modeling: Theory and Practice Heltier, W. Sipple, D. Ronyan (et al.). - Moscow: BINOM. Lab. Knowledge, 2009. – 318 p. http://lib.dvfu.ru:8080/lib/item?id=chamo:288823&theme=FEFU

5. Frenkel, D. Principles of Computer Modeling of Molecular Systems. From Algorithms to Applications / D. Frenkel, B. Smith; transl. from English and Sci. Eds.: V. A. Ivanov, M. R. Stukan. Moscow, Scientific World Publ., 2013. 559 p. (in Russian). http://lib.dvfu.ru:8080/lib/item?id=chamo:703930&theme=FEFU

6. Lesk, A. Vvedenie v bioinformatiku [Introduction to bioinformatics]. translated from English: Moscow: BINOM. Knowledge Lab, 2009. – 318 p. http://lib.dvfu.ru:8080/lib/item?id=chamo:288426&theme=FEFU

7. Romanovskiy I.V., Boltromenyuk V.V., Gidranovych L.G., Rineyskaya O.N.; Pod obz.red. I.V. Romanovsky. Moscow: New Knowledge, 2015. – 504 p. http://e.lanbook.com/books/element.php?pl1_id=64890

List of resources of the information and telecommunication network "Internet"

1. http://elibrary.ru/ - Scientific Electronic Library
2. http://molbiol.ru/ - Molecular Biology Information Resource

3. http://macroevolution.narod.ru/ is an electronic resource on evolutionary biology.
4. http://science.km.ru/ - electronic resource on different sections of biology
5. http://elementy.ru/ is an informational and educational resource dedicated to natural sciences.
6. http://www.iprbookshop.ru/ is **the IPRbooks electronic library system.**
7. http://znanium.com/ - EBS "Znanium".
8. https://nplus1.ru/ - N+1, a popular science online publication about science, engineering and technology
9. http://antropogenez.ru/ is a popular science information resource about human evolution
10. http://web.a.ebscohost.com/ehost/search/basic?sid=851485f8-6200-4b3e-aaab-df4ba7be3576@sessionmgr4008&vid=1&tid=2003EB is a collection of books on various sections from the EBSCOhost database.
11. http://rosalind.info/problems/locations/- resource for self-study of bioinformatics Rosalind.
12. http://www.ncbi.nlm.nih.gov/ website of the- National Center for Biotechnology Information (NCBI).
13. http://www.mendeley.com/- *Mendeley*: Free reference manager and PDF organizer; Librarian Program.
14. http:// www.ebi.ac.uk- website of the European Bioinformatics Institute
15. http:// www.scopus.com – Scopus bibliographic database and citation index
16. http://thomsonreuters.com/thomson-reuters-web-of-science/ Web of Science bibliographic database and citation index

List of information technologies and software

1. Microsoft Office Professional Plus 2013 is an office suite that includes software for working with various types of documents (texts, spreadsheets, databases, etc.);
2. 7Zip 16.04 - free file archiver with high data compression ratio;
3. Adobe Acrobat XI Pro is a software package for creating and viewing electronic publications in PDF format;
4. ESET Endpoint Security 5 is a comprehensive protection solution for Windows-based workstations. Virtualization support + new technologies;
5. WinDjView 2.0.2 is a program for recognizing and viewing files with the same DJV and DjVu formats; SolidWorks 2016 is a CAD software package for automating the work of an industrial enterprise at the stages of design and technological preparation of production
6. Notepad++ 6.68 – Text Editor

IX. METHODICAL INSTRUCTIONS FOR MASTERING THE DISCIPLINE

Lecture

The lecture is the- main active form of classroom classes, the explanation of the fundamental and most difficult theoretical sections of molecular biology and the theory of genetic engineering, which involves intensive mental activity of the student and is especially important for mastering the subject. A lecture should always be cognitive, developmental, educational and organizing. Lecture notes help to assimilate the theoretical material of the discipline. When listening to a lecture, you need to take notes main information, preferably with your own wording, which allows you to better remember the material. An outline is useful when it is written by the student independently.

In the lecture, the teacher gives only a small part of the material on certain topics that are presented in the textbooks. In addition, the instructor informs students about what additional information can be obtained on the topics discussed, and from what sources. Therefore, when working with lecture notes, it is always necessary to use the main textbooks, additional literature and other recommended sources on this discipline. It is this serious work of the student with the lecture material that allows him to achieve success in mastering new knowledge.

To present a lecture course on the discipline "Programming in Biomedicine", the following are used as forms of active learning: lecture-conversation, lecture-visualization, which are built on the basis of knowledge received by students in the framework of subjects preceding the course. Electronic presentations, tables, video files, and blackboard diagrams are used to illustrate verbal information. In the course of the lecture material, problematic questions or questions with elements of discussion are posed.

Lecture – visualization

The lecture is accompanied by the demonstration of tables, electronic presentations, video files - such a combination of ways of presenting information significantly simplifies its mastering by students. Verbal presentation of the material should be accompanied and combined with the visual form. The information presented in the form of diagrams on the board, tables, slides allows you to form problematic questions, and contribute to the development of professional thinking of future specialists.

Lecture-conversation

Lecture-conversation, "dialogue with the audience", is the most common form of active learning and allows students to be involved in the educational process, since there is direct contact between the teacher and the audience. Such contact is achieved during the lecture, when students are asked questions of a problematic or informational

nature, or when they are invited to ask the teacher questions themselves. Questions are offered to the entire audience, and any of the students can offer their own answer; another can complement it. In the course of the educational process, this allows you to identify the most active students and activate those who do not participate in the work. This form of lecture allows you to involve students in the work process, attract their attention, stimulate thinking, gain collective experience, and learn how to form questions. The advantage of a lecture-conversation is that it allows you to draw students' attention to the most important issues of the topic, determine the content and pace of the presentation of educational material, as well as determine the topics that are most interesting to students, in order to possibly adjust the form of the material taught.

Labs

They are used for conducting experiments, observations of phenomena and processes by students mainly in special laboratories, classrooms and with the use of technical means. This method stimulates action both in the preparation for research and in the process of its implementation. Laboratory work improves the quality of education, contributes to the development of cognitive activity in students, their logical thinking and creative independence. In the process of laboratory work, theoretical knowledge is deepened and concretized, and the ability to apply it in practice is developed. Skills in working with microscopes, tables and atlases are acquired. The student learns to analyze the data obtained, identify the norm and deviation from it, acquires the skills of working with a living object and physiological measuring devices, performing operations, conducting a comparative analysis, summarizing the material obtained and drawing conclusions. All this allows for a deeper understanding of the mechanisms of the functioning of a living organism and the principles of its interaction with the environment. Research skills and professional competencies are formed.

Traditionally, laboratory classes are the main type of training aimed at experimental confirmation of theoretical positions. In the course of a laboratory lesson, students perform one or more laboratory works (tasks) under the guidance of a teacher in accordance with the content of the educational material being studied. Students perform laboratory work aimed at:

- generalization, systematization, deepening of theoretical knowledge on specific topics of the academic discipline;
- formation of skills to accept the acquired knowledge in practical activities;
- development of analytical, design and constructive skills;
- development of independence, responsibility and creative initiative.

Necessary structural elements of the laboratory lesson:

- instruction given by the teacher;
- independent activities of students;
- Discussion of the results of the laboratory work (task).

Before completing the laboratory task (work), the students' knowledge is tested, i.e. their theoretical readiness to perform the task.

A laboratory task (work) can be reproductive, partially exploratory and exploratory in nature.

Works of **a reproductive** nature are distinguished by the fact that when conducting them, students use detailed instructions, which indicate: the purpose of the work, explanations (theory, main characteristics), equipment, apparatus, materials and their characteristics, the procedure for performing the work, tables, conclusions (without formulations), control questions, educational and special literature.

The works, which are of a **partial-exploratory** nature, are distinguished by the fact that during the conduct of the works, students do not use detailed instructions, they are not given the order of performing the necessary actions, students are required to independently select equipment, choose ways to perform work, instructive and reference literature.

Exploratory works are distinguished by the fact that students have to solve a problem that is new to them, relying on their theoretical knowledge.

The forms of organization of students for conducting a laboratory lesson - frontal, group and individual - are determined by the teacher, based on the topic, goal, and order of work. In the frontal form of organizing classes, all students do the same work. In the group form of organizing classes, the same work is carried out in teams of 2-5 people. With an individual form of organizing classes, each student performs an individual task.

The results of the laboratory task (work) are drawn up by students in the form of a report, the grades for the performance of the laboratory task (work) are indicators of the current performance of students in the academic discipline.

Research skills and professional competencies are formed.

Colloquia

Colloquium is a collective form of consideration and consolidation of educational material. Colloquia is one of the types of practical classes designed for in-depth study of the discipline, held in an interactive mode. In the classes on the topic of the colloquium, questions are analyzed, and then, together with the teacher, they are discussed, which is aimed at consolidating the material, forming polemic skills, developing independence and critical thinking, the ability of students to navigate in large information flows, to develop and defend their own position on problematic issues of the academic discipline.

As methods of interactive learning at colloquiums, the following are used: an extended conversation, a dispute, a press conference.

An extended conversation involves the preparation of students on each issue of the lesson plan with a single list of recommended mandatory and additional literature. Reports are prepared by students on a pre-proposed topic.

A dispute in a group has a number of advantages. A dispute can be caused by the teacher during the lesson or planned by him in advance.

Press conference. The teacher assigns several students to prepare short (thesis) reports. After the presentations, students ask questions, which are answered by the speakers and other members of the expert group. Based on the questions and answers, a creative discussion unfolds together with the teacher.

Case study method**.**The case-study method is a method of active problem-situational analysis based on learning by solving specific problems (case solving). The method of specific situations (case-study method) refers to non-game imitation active teaching methods and is considered as a tool that allows you to apply theoretical knowledge to solving practical problems. At the end of the lesson, the teacher tells a series of situations and offers to find solutions for those problems that are voiced in them. At the same time, the problem itself does not have unambiguous solutions. Students must analyze the situation, understand the essence of the problems, propose possible solutions and choose the best one. Thanks to the knowledge gained at the lecture, it is easy for the student to correlate the theoretical knowledge received with a real practical situation. As an interactive teaching method, it gains a positive attitude from students, who see it as an opportunity to take the initiative, feel independent in mastering theoretical provisions and mastering practical skills. No less important is the fact that the analysis of situations has a strong impact on the professionalization of students, contributes to their maturation, forms interest and positive motivation for learning. The method is aimed not so much at mastering specific knowledge or skills, as at developing the general intellectual and communicative potential of the student and the teacher.

It is a learning method designed to improve skills and gain experience in the following areas:

- identifying, selecting and solving problems;
- working with information – comprehending the meaning of the details described in the situation;
- analysis and synthesis of information and arguments;
- working with assumptions and conclusions;
- evaluation of alternatives;
- decision-making;
- Listening to and understanding other people is a group work skill. The main function of the case method is to teach students to solve complex unstructured problems that cannot be solved in an analytical way. The case activates students, develops analytical and communicative skills, leaving students face to face with real situations.

The case study is designed to increase the effectiveness of educational activities: as an illustration for solving a certain problem, explaining a particular phenomenon,

studying the features of its manifestations in real life, developing competence aimed at solving various life and work situations (the use of the case involves individual and group work of students).

Brainstorming is a widely used way of generating new ideas to solve scientific and practical problems. Its goal is to organize collective thinking to find non-traditional ways to solve problems.

The use of the brainstorming method in the educational process allows you to solve the following tasks:

- creative assimilation of educational material by students;
- connection of theoretical knowledge with practice;
- • activation of educational and cognitive activities of students;
- formation of the ability to concentrate attention and mental efforts on the solution of an urgent task;
- formation of the experience of collective thinking activity.

The problem formulated in the brainstorming class should have theoretical or practical relevance and arouse the active interest of students. A common requirement that must be taken into account when choosing a problem for brainstorming is the possibility of many ambiguous solutions to the problem, which is put forward to students as a learning task.

Quizzes & Testing

Current control of material assimilation is assessed by oral answers, tests, as well as paper testing.

Assessments of laboratories, colloquiums, tests and testing mainly form the grade for this discipline.

MATERIAL AND TECHNICAL SUPPORT OF DISCIPLINE

Logistical and software of the discipline

Name of special rooms and rooms for independent work	Equipment of special rooms and rooms for independent work	List of licensed software. Details of the supporting document
Lecture hall: 690922, Primorsky Krai, Vladivostok, Russky Island, Saperny Peninsula, Ajax village, 10, aud. M 421	DLP projector, 3000 ANSI Lm, WXGA 1280x800, 2000:1 EW330U Mitsubishi; CORSA-2007 Tuarex Specialized Equipment Fastening Subsystem; Video Switching Subsystem: Extron DXP 44 DVI Pro DVI Matrix Switcher; Extron DVI 201 Tx/Rx twisted-pair DVI extender Audio switching	Windows Seven Enterprice SP3x64 (Microsoft License Number Standard Enrollment 62820593. End date: 2020-06-30. Campus 3 Parent Program 49231495. Reseller: JSC "Softline Trade" Reseller Order Number: Tr000270647-18.) Eset NOD32 Antivirus 4.2.76.1 (Contract No. EA-091-18 dated 24.04.2018. Microsoft Office 2010 Professional Plus 14.0.6029.1000 (Microsoft

	and sound amplification subsystem; Extron SI 3CT LP Ceiling Mount Speaker System Extron DMP 44 LC Digital Audio Processor; extension for IPL T CR48 control controller.	License Number Standard Enrollment 62820593. End Date 2020-06-30. Parent Program Campus 3 49231495. Reseller: JSC "Softline Trade" Reseller Order Number: Tr000270647-18.) Microsoft Office Professional Plus 2013 15.0.4420.1017 (Microsoft License Number Standard Enrollment 62820593. End Date 2020-06-30. Parent Program Campus 3 49231495. Reseller: JSC "Softline Trade" Reseller Order Number: Tr000270647-18.) Google Chrome 42.0.2311.90 (Free Software)
Computer class of the School of Biomedicine aud. M723, 15 workplaces	Electric Screen 236*147cm Trim Screen Line; DLP projector, 3000 ANSI Lm, WXGA 1280x800, 2000:1 EW330U Mitsubishi; CORSA-2007 Tuarex Specialized Equipment Fastening Subsystem; Video Switching Subsystem: Extron DXP 44 DVI Pro DVI Matrix Switcher; Extron DVI 201 Tx/Rx twisted-pair DVI extender Audio switching and sound amplification subsystem; Extron SI 3CT LP Ceiling Mount Speaker System Extron DMP 44 LC Digital Audio Processor; extension for IPL T CR48 control controller; Wireless LAN for students is provided by a system based on 802.11a/b/g/n 2x2 MIMO(2SS) access points. Моноблок HP ProOne 400 All-in-One 19.5 (1600x900), Core i3-4150T, 4GB DDR3-1600 (1x4GB), 1TB HDD 7200 SATA, DVD+/-RW, GigEth, Wi-Fi, BT, usb kbd/mse, Win7Pro (64-	Microsoft Office Professional Plus 2013 is an office suite that includes software for working with various types of documents (texts, spreadsheets, databases, etc.); 7Zip 16.04 - free file archiver with high data compression ratio; Adobe Acrobat XI Pro is a software package for creating and viewing electronic publications in PDF format; AutoCAD Electrical 2015 - three-dimensional computer-aided design and drafting system; ESET Endpoint Security 5 is a comprehensive protection solution for Windows-based workstations. Virtualization support + new technologies; WinDjView 2.0.2 is a program for recognizing and viewing files with the same DJV and DjVu formats; SolidWorks 2016 is a CAD software package for automating the work of an industrial enterprise at the stages of design and technological preparation of production Compass-3D LT V12 - Three-Dimensional Simulation System Notepad++ 6.68 – Text Editor

	bit)+Win8.1Pro(64-bit), 1-1-1 Wty	
Classrooms for self-study: Reading rooms of the FEFU Scientific Library with open access to the collection (building A - level 10)	HP RgoOpe 400 All-in-One 19.5 (1600x900), Core i3-4150T, 4GB DDR3-1600 (1x4GB), 1TB HDD 7200 SATA, DVD+/-RW,GigEth,Wi-Fi,VT,usb kbd/mse,Win7Pro (64-bit)+Win8.1Pro(64-bit),1-1-1 Wty Internet access speed 500 Mbps. Workplaces for people with disabilities are equipped with displays and Braille printers; equipped with: portable devices for reading flat-printed texts, scanning and reading machines, a video magnifier with the ability to adjust color spectrums; magnifying electronic magnifiers and ultrasonic markers.	Windows Seven Enterprice SP3x64 (Microsoft License Number Standard Enrollment 62820593. End date: 2020-06-30. Campus 3 Parent Program 49231495. Reseller: JSC "Softline Trade" Reseller Order Number: Tr000270647-18.) Eset NOD32 Antivirus 4.2.76.1 (Contract No. EA-091-18 dated 24.04.2018. Microsoft Office 2010 Professional Plus 14.0.6029.1000 (Microsoft License Number Standard Enrollment 62820593. End Date 2020-06-30. Parent Program Campus 3 49231495. Reseller: JSC "Softline Trade" Reseller Order Number: Tr000270647-18.) Microsoft Office Professional Plus 2013 15.0.4420.1017 (Microsoft License Number Standard Enrollment 62820593. End Date 2020-06-30. Parent Program Campus 3 49231495. Reseller: JSC "Softline Trade" Reseller Order Number: Tr000270647-18.) Google Chrome 42.0.2311.90 (Free Software)
Classrooms for practical and laboratory work: 690922, Primorsky Krai, Vladivostok, Russky Island, Saperny Peninsula, Ajax village, 10, aud. M 432, 431	Laboratory of Biochemistry: Dry-air thermostat MIR-262; Pioneer Precision Scales (PA413); Laboratory centrifuge LMC-4200R; MSH-300i Magnetic Stirrer with Thermal Regulation; Distiller GFL-2008; Electric stove Mechta 111H; Spectrophotometer with BioSpectrometer-kinetic Sample Processing Accessories Mkmed-5 medical microscope, Hematology Analyzer XP-300	

	Panchenkov's apparatus Goryaev's Chamber Laboratory counter S-5 DocUReader 2 Pro Urine Analyzer Photometer KFK-Z-01—"ZOMZ" photovoltaic Wash StatFax 2600 Shaker Thermostat ST-3M Medical Photometers for iMark microplates	