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
Head of Educational Program
_____ V.V. Kumeiko
(Signed) (Surname)

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

WORK PROGRAM OF THE DISCIPLINE
Molecular Biotechnology
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 the Russian Federation dated 07.08.2020 No. 9 20

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

Reverse side 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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4. 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.*

5. 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.*

Abstract of the discipline

Molecular Biotechnology

The total labor intensity of the discipline is 3 credits.
108 academic hours. It is a discipline of the elective part of the EP, studied in the 5 t h year and ends *with a test.* The curriculum provides for 18 hours of lectures, *18* hours of laboratory work, *36* hours of practical work, and *36 hours* of independent work for the student.

The language of the program is Russian.

Purpose of the course:

With the latest achievements in the field of science, which arose and is developing on the achievements of molecular biotechnology, microbiology, biochemistry, genetics, virology, and others. The lectures give an idea of how recombinant DNA technology can be used to create the products that humans need. Issues related to the basics of molecular biotechnology and the possibility of improving biotechnological processes on this basis are considered.

Objectives of the discipline:

1. To form students' understanding of molecular biotechnology as a relevant field.

2. To form competencies in the field of biomedical technologies, as well as methods of their production.

3. To acquire the practical skills necessary for the performance of labor functions in the biomedical biotechnology sector.

Professional competencies of graduates and indicators of their achievement:

Task type	Code and name Competencies (result of mastering)	Code and name of the competency indicator	Name of the assessment indicator (the result of learning in the discipline)
project	PC-2 Applies biotechnology and bioengineering methods to the development and production of medicines, medical devices, biomedical cell products and medical diagnostic systems	PC-2.1 Uses fundamental knowledge of molecular and cellular biology to put genetic and cellular engineering technologies into practice	Knows methods of biotechnology and bioengineering. Can apply biotechnology and bioengineering techniques. Owns skills in obtaining medicines, medical devices, biomedical cell products and medical diagnostic systems.
		PC-2.2 Able to apply genetic and cellular engineering methods to the development and	Knows methods of genetic and cellular engineering. Can

		production of medicines, medical devices, biomedical cell products and medical diagnostic systems	apply genetic and cellular engineering methods. Owns the ability to obtain medicines, medical devices, biomedical cell products and medical diagnostic systems.
		PC-2.3 Able to analyze the results of an experiment in the field of biotechnology and bioengineering and carry out the development of medicines, medical devices, biomedical cell products and medical diagnostic systems	Knows Specifics of the development of medicines, medical devices, biomedical cell products and medical diagnostic systems. Can analyze the results of an experiment in the field of biotechnology and bioengineering Owns skills in the development of medicines, medical devices, biomedical cell products and medical diagnostic systems.
		PC-2.4 Able to transfer the results of research work in the field of biotechnology and bioengineering for the development and production of medicines, medical devices, biomedical cell products and medical diagnostic systems	Knows Specifics of the development of medicines, medical devices, biomedical cell products and medical diagnostic systems. Can to transfer the results of research work in the field of biotechnology and bioengineering. Owns skills in the development of medicines, medical devices, biomedical cell products and medical diagnostic systems.

For the formation of the above competencies within the discipline "Molecular Biotechnology" uses the following educational technologies and methods of active/interactive learning: business game, work in small groups, round table.

I. Goals and objectives of mastering the discipline:

Objective: To bring together the latest achievements in the field of science, which has arisen and is developing on the achievements of molecular biotechnology, microbiology, biochemistry, genetics, virology, and others. The lectures provide an idea of how recombinant DNA technology can be used to create products that humans need. Issues related to the basics of molecular biotechnology and the possibility of improving biotechnological processes on this basis are considered.

Tasks:

1. To form students' understanding of molecular biotechnology as a relevant field.

2. To form competencies in the field of biomedical technologies, as well as methods of their production.

3. To acquire the practical skills necessary for the performance of labor functions in the biomedical biotechnology sector.

Professional competencies of graduates and indicators of their achievement:

Task type	Code and name Competencies (result of mastering)	Code and name of the competency indicator	Name of the assessment indicator (the result of learning in the discipline)
project	PC-2 Applies biotechnology and bioengineering methods to the development and production of medicines, medical devices, biomedical cell products and medical diagnostic systems	PC-2.1 Uses fundamental knowledge of molecular and cellular biology to put genetic and cellular engineering technologies into practice	Knows methods of biotechnology and bioengineering. Can apply biotechnology and bioengineering techniques. Owns skills in obtaining medicines, medical devices, biomedical cell products and medical diagnostic systems.
		PC-2.2 Able to apply genetic and cellular engineering methods to the development and production of medicines, medical devices, biomedical cell products and medical diagnostic systems	Knows methods of genetic and cellular engineering. Can apply genetic and cellular engineering methods. Owns the ability to obtain medicines, medical devices, biomedical cell products and medical diagnostic systems.
		PC-2.3 Able to analyze the results of an experiment in the field of	Knows Specifics of the development of medicines, medical devices,

		biotechnology and bioengineering and carry out the development of medicines, medical devices, biomedical cell products and medical diagnostic systems	biomedical cell products and medical diagnostic systems. Can analyze the results of an experiment in the field of biotechnology and bioengineering Owns skills in the development of medicines, medical devices, biomedical cell products and medical diagnostic systems.
		PC-2.4 Able to transfer the results of research work in the field of biotechnology and bioengineering for the development and production of medicines, medical devices, biomedical cell products and medical diagnostic systems	Knows Specifics of the development of medicines, medical devices, biomedical cell products and medical diagnostic systems. Can to transfer the results of research work in the field of biotechnology and bioengineering. Owns skills in the development of medicines, medical devices, biomedical cell products and medical diagnostic systems.

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

The total labor intensity of the discipline is 3 credit units (108 academic hours), (1 credit corresponds to 36 academic hours).

II. 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	Topic 1-2	7	3	3	6	-	36	-	Questions for the test
2	Topic 3-4		4	4	8	-			

3	Topic 5-6		4	4	8	-			
4	Topic 7-8		4	4	8	-			
5	Topic 9		3	3	6	-			
	Total:	7	18	18	36	-	36	-	Credit

III. CONTENT OF THE THEORETICAL PART OF THE COURSE

Lecture

Topic 1. Introduction. Molecular biotechnology as the main direction in the development of general biotechnology.

Molecular biotechnology as the main direction in the development of general biotechnology. The emergence of molecular biotechnology and the history of its development. Molecular-biotechnological revolution in biology. Recombinant DNA technology. Hopes and fears. Commercialization of molecular biotechnology.

Topic 2. Basic Elements and Processes Used in Molecular Biotechnology. Biological systems used in molecular biotechnology. Chemical synthesis, nucleotide sequencing, and DNA amplication.

Basic Elements and Processes Used in Molecular Biotechnology. The structure of DNA. Replication. Deciphering genetic information: RNA and protein. Translation. Regulation of transcription in bacteria. Regulation of transcription in eukaryotes. Biological systems used in molecular biotechnology. Prokaryotes and eukaryotes. Escherichia coli and Saccharomyces cerevisiae as the main bioagents in the development of molecular genetic studies. Eukaryotic cell cultures. Chemical synthesis, nucleotide sequencing, and DNA amplication. Chemical synthesis of DNA. Phosphoramidite method. Use of synthesized oligonucleotides. Gene synthesis. DNA sequencing methods. Polymerase chain reaction.

Topic 3. Recombinant DNA technology. Optimization of gene expression cloned in prokaryotic systems.

Restrictive endonucleases. Plasmid vectors. Transformation and selection. Creation and screening of libraries. Cloning of structural genes in eukaryotes. Vectors and vector systems for cloning large DNA fragments. Bacteriophage-based vectors. Cosmids. Genetic transformation of prokaryotes. DNA transfer to E. coli.

Electroporation. Conjugation. Optimization of gene expression cloned in prokaryotic systems. Regulated promoters. Gene expression by strong regulated promoters. Large-scale systems. Use for gene expression of other microorganisms. Chimeric proteins, their cleavage and application. Translational expression vectors. Protein stabilization. Integration of foreign DNA into the host chromosome. Increased secretion efficiency. Metabolic overload of objects: Obtaining DNA from plant material.

Topic 4. Production of recombinant proteins by eukaryotic systems.

Expression systems of Saccharomyces segevisiae. Vectors for S. cerevisiae. Direct expression in S. cerevisiae. Secretion of heterologous proteins synthesized by S. cerevisiae. Other yeast expression systems. Synthesis of hepatitis B virus surface antigen. Synthesis of bovine lysozyme C2. Expression systems using insect cell cultures. A system of expression vectors based on baculoviruses. Production of recombinant baculoviruses. Creation of a shuttle vector based on baculoviruses for E. coli and insect cells. Isolation of recombinant protein from insect cells by affinity binding. Expression vectors for working with mammalian cells. Selective marker genes. Expression of two cloned genes in a single mammalian cell.

Topic 5. Directed mutagenesis and genetic engineering of proteins:

Directed Mutagenesis: Technique. Oligonucleotide-directed mutagenesis using M13 phage DNA. Oligonucleotide-directed mutagenesis using plasmid DNA. Oligonucleotide-directed mutagenesis using PCR amplification. Random mutagenesis using oligonucleotide primers. Random mutagenesis using nucleotide analogues. Genetic engineering of proteins. Formation of additional disulfide bonds. Replacement of asparagine with other amino acids. Reduction in the number of free sulfhydryl groups. Increased enzymatic activity. Change in enzyme requirements for metallic cofactors. Change in enzyme specificity. Increasing the stability and specificity of the enzyme protein:

Creation of a highly productive mutant microorganism.

Topic 6. Molecular Biotechnology of Microbiological Systems Biotechnological processes involving recombinant microorganisms.

Growth of microorganisms. Periodic culture. Batch culture with the addition of substrate. Continuous culture. Improve fermentation efficiency. High-density crops. Bioreactors. Typical part-scale fermentation systems. Two-stage fermentation in tandem airlift bioreactors. Two-stage fermentation in one reactor with mechanical agitation. Batch fermentation and batch fermentation with the addition of substrate. Cell collection. Cell destruction. Further processing. Solubilization of proteins.

Topic 7. Medicine and Immunobiotechnology Microbiological Production of Medicines.

Medicines. Human interferons obtained by genetic engineering. Genetically engineered human growth hormone. Optimization of gene expression. Enzymes. Monoclonal antibodies as medicines. Hybrid human-mouse monoclonal antibodies. Production of antibodies by E. coli. Anti-HIV medicines.

Topic 8. Vaccine. Molecular diagnostics:

Different types of vaccines. Genetically engineered vaccines. Gene immunization. Bacteria as antigen delivery systems. Molecular diagnostics. Methods of immunodiagnostics. Enzyme immunosorbent assay. Monoclonal antibodies. Formation and selection of hybrid cells. Identification of hybrid cell lines secreting specific antibodies. DNA diagnostic systems. Hybridization probes. Non-radioactive methods of detection. Genomic fingerprinting. Use of polymorphic DNA markers. Molecular diagnostics of genetic diseases. Prospects for the use of molecular diagnostics.

Topic 9. Use of recombinant microorganisms to obtain commercial products for various purposes. Biodegradation of toxic compounds and utilization of biomass.

Synthesis of L-ascorbic acid. Indigo synthesis. Synthesis of amino acids. Antibiotics. Cloning of antibiotic biosynthesis genes. Synthesis of new antibiotics. Improving the production of antibiotics. Biopolymers: xanthan, melanin, rubber, polyhydroxyalkanoates. Biodegradation of toxic compounds and utilization of biomass. Metabolic pathways of xenobiotic biodegradation created by genetic engineering methods. Utilization of starch and sugars. Industrial production of fructose and ethanol. Silage production. Cellulose utilization. Lignocellulose components. Isolation of prokaryotic cellulase genes. Isolation of eukaryotic cellulase genes. Manipulation of cellulase genes.

Topic 10. Agriculture and ecology Bacteria that stimulate plant growth. Microbial insecticides.

Nitrogen fixation. Genetic engineering of a nitrogenase gene cluster. Formation of nodules. Competition among organisms that form nodules. Manipulation of genes for the formation of nodules. Biocontrol of pathogenic microorganisms. Siderophores. Antibiotics. Enzymes. Formation of ice crystals and antifreeze proteins. Stimulation of plant growth by free-living bacteria. Microbial insecticides. A toxin synthesized by Bacillus thuringiensis. Mechanism of action and uses. Identification of toxin genes. Genetic engineering of the toxin genes of B. thuringiensis. Baculoviruses as a biocontrol tool. Mechanism of action. Strengthening biocontrol through genetic engineering.

Topic 11. Molecular Biotechnology of Eukaryotic Systems Plant Genetic Engineering: Methodology and Application. Transgenic animals.

Transformation of plants by Ti-plasmid from Agrobacterium tumefaciens. Vector systems based on Ti-plasmids. Physical methods of gene transfer into plant

cells. Bombardment with microparticles. Application of reporter genes in the transformation of plant cells. Experiments on the expression of foreign genes in plants. Identification of different promoters and their use. Introduction of foreign genes into chloroplast DNA. Production of transgenic plants that do not contain marker genes. Genetic Engineering of Plants: Applications. Breeding plants that are resistant to insect pests, viruses and herbicides. Plants that are resistant to fungi and bacteria. Obtaining plants that resist adverse effects and aging. Oxidative stress. Salt stress. Ripening of fruits. Change in the color of the flowers. Changes in the nutritional value of plants. Amino acids. Lipids. Changes in the taste and appearance of fruits. Plants as bioreactors. Antibodies. Polymers. Foreign proteins that accumulate in seeds. Transgenic animals. Transgenic Mice: Methodology. Use of retroviral vectors. DNA microinjection method. Use of modified embryonic stem cells. Cloning with kernel transfer. Gene transfer using artificial yeast chromosomes. Transgenic mice: application. Transgenic cattle. Transgenic sheep, goats and pigs. Transgenic birds and fish.

Topic 12. Human Molecular Genetics. Gene therapy.

Genetic linkage and mapping of human genes. Constructing genetic maps of human chromosomes. Genetic polymorphism. Polymorphism. Mapping the locus of a genetic disease at a specific region of the chromosome. Construction of multilocus human chromosome maps. Localization of the disease gene on the linkage map. Cloning of human disease genes. Detection of mutations in human genes. Functional mapping. Candidate mapping. Positional mapping. Positional-candidate mapping. Human Genome Program. Ex vivo gene therapy. In vivo gene therapy. Viral gene delivery systems. Retroviral vectors. Adenoviral vectors. Vectors based on adeno-associated viruses. Vectors based on herpes simplex virus. Non-viral gene delivery systems. Activation of the drug precursor (prodrug). Oligonucleotide-based drugs. Protein-binding oligonucleotides: antithrombin aptamer. Ribozymes as medicines. Correction of genetic defects with oligonucleotides.

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

Practical exercises

Topic 1. Introduction. Molecular biotechnology as the main direction in the development of general biotechnology.

Topic 2. Basic Elements and Processes Used in Molecular Biotechnology. Biological systems used in molecular biotechnology. Chemical synthesis, nucleotide sequencing, and DNA amplication.

Topic 3. Recombinant DNA technology. Optimization of gene expression cloned in prokaryotic systems.

Topic 4. Production of recombinant proteins by eukaryotic systems.

Topic 5. Directed mutagenesis and genetic engineering of proteins.

Topic 6. Molecular Biotechnology of Microbiological Systems. Biotechnological processes involving recombinant microorganisms.

Topic 7. Medicine and immunobiotechnology. Microbiological production of medicines.

Topic 8. Vaccine. Molecular diagnostics.

Topic 9. Use of recombinant microorganisms to obtain commercial products for various purposes. Biodegradation of toxic compounds and utilization of biomass.

Topic 10. Agriculture and ecology. Bacteria that stimulate plant growth. Microbial insecticides.

Topic 11. Molecular biotechnology of eukaryotic systems. Gene
Plant Engineering: Methodology and Application. Transgenic animals.

Topic 12. Human Molecular Genetics. Gene therapy.

Labs

Topic 1. Obtaining DNA from plant material.

Topic 2. Creation of a highly productive mutant microorganism.

Topic 3. DNA electrophoresis and determination of its concentration.

Topic 4. Bacteriophage production.

Topic 5. Study of viability and phase distribution of the cell cycle by flow cytometry methods.

Self-paced work

Recommended Essay Topics.

1. Gene characteristics of eukaryotes and prokaryotes.
2. Types of vectors and plasmids. Their nomenclature, classification, working conditions. Principles of using restrectases, ligases, classification of enzymes. Methods of DNA separation and detection.
3. DNA sequencing methods. Chemical DNA Synthesis, Polymerase Chain Reaction (PCR), Choice of Primers and Reaction Conditions. Requirements for reagents required for sequencing and PCR.
4. Characteristics of proteins that determine their functionality. Use of yeast and E. coli to produce recombinant proteins.
5. Methods for Identification of Protein Molecule Interaction Sites. Work in the database, INTERACT. Introduction of new functional groups.

6. Methods of immunodiagnostics, DNA diagnostics, diagnostics of hereditary diseases. The latest methods of analysis using antibodies: flowing.

7. Microbiological production of drugs, enzymes, antibodies for diagnostic systems, vaccines, antibiotics and biopolymers. Use of by-products of microbiological production and the level of their safety.

8. Techniques for extracting the target product. Scaling up the technological process of microbiological synthesis.

9. Methods of transformation of a plant cell using plasmids, vectors, microparticles, physical methods of gene transfer. Application of Plant Genetic Engineering. Positive and negative experience of using transgenic plants. Areas of use of transgenic animals. Limitations on the application of animal model results to the human body.

10. Human Genome Analysis, Gene Mapping, Chromasome Mapping, Human Gene Cloning, Gene Polymorphism. Genetic abnormalities Analysis of human gene abnormalities using BrainSpan, CIDeR Database.

11. General Principles of Patenting Biotechnological Inventions. Drafting of patent documentation

VI. EDUCATIONAL AND METHODOLOGICAL SUPPORT OF STUDENTS' INDEPENDENT WORK

Independent work is defined as individual or collective learning activities carried out without the direct supervision of the teacher, but according to his tasks and under his supervision. Independent work is a cognitive learning activity, when the sequence of the student's thinking, his mental and practical operations and actions depends and is determined by the student himself.

Independent work of students contributes to the development of independence, responsibility and organization, a creative approach to solving problems at the educational and professional levels, which ultimately leads to the development of the skill of independent planning and implementation of activities.

The purpose of students' independent work is to acquire the necessary competencies in their field of training, experience in creative and research activities.

Forms of independent work of students:

- work with basic and additional literature, Internet resources;
- independent acquaintance with the lecture material presented on electronic media, in the library of an educational institution;
- preparation of abstract reviews of periodical press sources, reference notes, predetermined by the teacher;

- search for information on the topic with its subsequent presentation in the audience in the form of a report, presentations;
- preparation for classroom tests;
- Performing home tests;
- Performance of test tasks, problem solving;
- compilation of crosswords, schemes;
- preparation of reports for presentation at a seminar, conference;
- filling in the workbook;
- writing essays, term papers;
- preparation for business and role-playing games;
- Writing a resume;
- preparation for tests and exams;
- other types of activities organized and carried out by the educational institution and student self-government bodies.

Guidelines for writing and formatting an abstract

An essay is a creative activity of a student, which reproduces in its structure research activities to solve theoretical and applied problems in a certain branch of scientific knowledge. For this reason, coursework is the most important component of the educational process in higher education.

An essay, being a model of scientific research, is an independent work in which the student solves a problem of a theoretical or practical nature, applying scientific principles and methods of this branch of scientific knowledge. The result of this scientific research can have not only subjective, but also objective scientific novelty, and therefore can be presented for discussion by the scientific community in the form of a scientific report or a report at a scientific and practical conference, as well as in the form of a scientific article.

The abstract involves the acquisition of skills for building business cooperation based on ethical standards of scientific activity. Purposefulness, initiative, disinterested cognitive interest, responsibility for the results of one's actions, conscientiousness, competence are the personal qualities that characterize the subject of research activities that correspond to the ideals and norms of modern science.

An essay is an independent educational and research activity of a student. The instructor provides advice and evaluates the process and results. He provides an approximate topic of abstracts, clarifies the problem and topic of research together with students, helps to plan and organize research activities, appoints a time and a minimum number of consultations.

The teacher accepts the text of the essay for review at least ten days before the defense.

Traditionally, there is a certain structure of the abstract, the main elements of which, in the order of their arrangement, are the following:

1. Title page.
2. Task.
3. Table of Contents.
4. List of symbols, symbols and terms (if necessary).
5. Introduction.
6. Main part.
7. Conclusion.
8. References.
9. Applications.

The title page indicates: educational institution, graduating department, author, teacher, research topic, place and year of the abstract.

The title of the abstract should be as brief as possible and fully correspond to its content.

The table of contents (contents) reflects the names of the structural parts of the abstract and the pages on which they are located. It is advisable to place the table of contents at the beginning of the work on one page.

The presence of a detailed introduction is a mandatory requirement for the abstract. Despite the small volume of this structural part, its writing causes significant difficulties. However, it is the high-quality introduction that is the key to understanding the entire work, testifying to the professionalism of the author.

Thus, the introduction is a very important part of the abstract. The introduction should begin with a justification of the relevance of the chosen topic. When applied to an abstract, the concept of "relevance" has one peculiarity. The author's ability to choose a topic and how correctly he understands and evaluates this topic from the point of view of modernity and social significance characterizes his scientific maturity and professional preparedness.

In addition, in the introduction, it is necessary to identify the methodological base of the abstract, name the authors whose works formed the theoretical basis of the study. A review of the literature on the topic should show the author's thorough familiarity with specialized literature, his ability to systematize sources, critically consider them, highlight the essential, and determine the main thing in the current state of study of the topic.

The introduction reflects the significance and relevance of the chosen topic, defines the object and subject, the purpose and objectives, and the chronological framework of the study.

The introduction concludes with a statement of general conclusions about the scientific and practical significance of the topic, the degree of its study and provision with sources, and the formulation of a hypothesis.

In the main part, the essence of the problem is stated, the topic is revealed, the author's position is determined, factual material is provided as an argument and to illustrate the proposed provisions. The author needs to demonstrate the ability to consistently present the material while simultaneously analyzing it. Preference is given to the main facts rather than small details.

The abstract ends with the final part, which is called the "conclusion". Like any conclusion, this part of the abstract plays the role of a conclusion conditioned by the logic of the research, which is in the form of a synthesis of the scientific information accumulated in the main part. This synthesis is a consistent, logically harmonious presentation of the results obtained and their correlation with the general goal and specific tasks set and formulated in the introduction. It is here that the so-called "inferential" knowledge is contained, which is new in relation to the original knowledge. The conclusion may include suggestions of a practical nature, thereby increasing the value of the theoretical materials.

So, the conclusion of the abstract should include: a) the conclusions of the study; b) theoretical and practical significance, novelty of the abstract; c) the possibility of applying the results of the study is indicated.

After the conclusion, it is customary to place a bibliographic list of the references. This list is one of the essential parts of the abstract and reflects the independent creative work of the author of the abstract.

A list of the sources used is placed at the end of the work. It is formatted either in alphabetical order (by the author's surname or the title of the book), or in the order in which references appear in the text of the written work. In all cases, the full title of the work, the surnames of the authors or the editor of the publication, if a team of authors participated in the writing of the book, data on the number of volumes, the name of the city and publishing house in which the work was published, the year of publication, the number of pages are indicated.

Guidelines for Preparing Presentations

To prepare a presentation, it is recommended to use: PowerPoint, MS Word, Acrobat Reader, LaTeX beamer package. The easiest program to create presentations is Microsoft PowerPoint. To prepare a presentation, it is necessary to process the information collected when writing the abstract.

Sequence of presentation preparation:

1. Clearly state the purpose of the presentation.

2. Determine what the format of the presentation will be: live performance (how long it will be) or e-mailing (what will be the context of the presentation).

3. Select all the content for the presentation and build a logical chain of presentation.

4. Identify the key points in the content of the text and highlight them.

5. Determine the types of visualization (pictures) to be displayed on slides in accordance with the logic, purpose and specifics of the material.

6. Choose the design and format of the slides (the number of pictures and text, their location, color and size).

7. Check the visual perception of the presentation.

Types of visualization include illustrations, images, diagrams, tables. An illustration is a representation of a real-life visual series. Images, as opposed to illustrations, are metaphors. Their purpose is to evoke an emotion and create an attitude towards it, to influence the audience. With the help of well-thought-out and presented images, information can remain in a person's memory for a long time. Diagram – visualization of quantitative and qualitative relationships. They are used for convincing demonstration of data, for spatial thinking in addition to logical thinking. A table is a concrete, visual and accurate display of data. Its main purpose is to structure information, which sometimes makes it easier for the audience to perceive the data.

Practical tips for preparing a presentation

– printed text + slides + handouts are prepared separately;

– slides – visual presentation of information, which should contain a minimum of text, a maximum of images that carry a semantic load, look clear and simple;

– Textual content of the presentation – oral speech or reading, which should include arguments, facts, evidence and emotions;

– Recommended number of slides 17-22

– mandatory information for the presentation: topic, surname and initials of the speaker; Communication plan brief conclusions from all that has been said; list of references;

– Handouts – should provide the same depth and reach as a live performance: people trust what they can take with them more than disappearing images, words and slides are forgotten, and the handout remains a constant tangible reminder; Handouts should be given out at the end of the presentation, handouts should be different from slides, should be more informative.

Criteria for evaluating the abstract.

The stated understanding of the abstract as an integral author's text determines the criteria for its evaluation: novelty of the text; the reasonableness of the choice of source; the degree of disclosure of the essence of the issue; compliance with the design requirements.

Novelty of the text: a) relevance of the research topic; b) novelty and independence in the formulation of the problem, formulation of a new aspect of the known problem in the establishment of new connections (interdisciplinary, intra-subject, integration); c) ability to work with research, critical literature, systematize and structure material; d) the manifestation of the author's position, the independence of assessments and judgments; e) stylistic unity of the text, unity of genre features.

Degree of disclosure of the essence of the issue: a) correspondence of the plan to the topic of the abstract; b) correspondence of the content to the topic and outline of the abstract; c) completeness and depth of knowledge on the topic; d) the validity of the ways and methods of working with the material; f) the ability to generalize, draw conclusions, compare different points of view on one issue (problem).

Validity of the choice of sources: a) assessment of the literature used: whether the most well-known works on the topic of research are involved (including journal publications of recent years, the latest statistical data, summaries, references, etc.).

Compliance with formatting requirements: a) how correctly the references to the literature used, the list of references; b) assessment of literacy and culture of presentation (including spelling, punctuation, stylistic culture), knowledge of terminology; c) compliance with the requirements for the length of the abstract.

The reviewer should clearly formulate a comment and questions, preferably with references to the work (it is possible to specific pages of the work), to research and factual data that the author did not take into account.

The reviewer can also indicate: whether the student has addressed the topic before (essays, written works, creative works, Olympiad works, etc.) and whether there are any preliminary results; how the graduate conducted the work (plan, intermediate stages, consultation, revision and revision of the written or lack of a clear plan, rejection of the recommendations of the supervisor).

The student submits an abstract for review no later than one week before the defense. The reviewer is the teacher. Experience shows that it is advisable to familiarize the student with the review a few days before the defense. Opponents are appointed by a teacher from among the students. For an oral presentation, 10-20 minutes is enough for a student (this is approximately the time he answers on the exam tickets).

Grade 5 is given if all the requirements for writing and defending an abstract are met: the problem is identified and its relevance is justified, a brief analysis of various points of view on the problem under consideration is made and one's own position is logically stated, conclusions are formulated, the topic is fully

disclosed, the volume is maintained, the requirements for external design are met, and correct answers to additional questions are given.

Grade 4 – the main requirements for the abstract and its defense have been met, but at the same time there are shortcomings. In particular, there are inaccuracies in the presentation of the material; there is no logical consistency in judgments; the length of the abstract is not maintained; there are omissions in the design; Incomplete answers were given to additional questions during the defense.

Grade 3 – there are significant deviations from the abstract requirements. In particular, the topic is covered only partially; factual errors were made in the content of the abstract or in answering additional questions; There is no conclusion during the defense.

Grade 2 – the topic of the abstract is not disclosed, a significant misunderstanding of the problem is revealed.

Grade 1 – the abstract is not submitted by the student.

VII. MONITORING THE ACHIEVEMENT OF THE COURSE OBJECTIVES

No. p/p	Supervised sections/topics of the discipline	Code and name of the indicator of achievement	Learning Outcomes	Evaluation Tools	
				Current control	Intermediate Certification
1	Topic 1. Introduction. Molecular biotechnology as the main direction in the development of general biotechnology.	PC-2.1 Uses fundamental knowledge of molecular and cellular biology to put genetic and cellular engineering technologies into practice	Knows methods of biotechnology and bioengineering. Can apply biotechnology and bioengineering techniques. Owns skills in obtaining medicines, medical devices, biomedical cell products and medical diagnostic systems.	Oral Questioning	Questions for the test
2	Topic 2. Basic Elements and Processes Used in Molecular Biotechnology. Biological systems used in molecular biotechnology. Chemical synthesis, nucleotide sequencing, and DNA amplication.			Oral Questioning	Questions for the test
3	Topic 3. Recombinant DNA technology. Optimization of gene expression cloned in prokaryotic systems.			Test	Questions for the test
4	Topic 4. Production of recombinant proteins by eukaryotic systems.	PC-2.2 Able to apply genetic and cellular engineering methods to the development and production of medicines, medical devices, biomedical cell products and medical diagnostic systems	Knows methods of genetic and cellular engineering. Can apply genetic and cellular engineering methods. Owns the ability to obtain medicines, medical devices, biomedical cell products and medical diagnostic systems.	Colloquium	Questions for the test
5	Topic 5. Directed mutagenesis and genetic engineering of proteins.			Oral Questioning Colloquium	Questions for the test
6	Topic 6. Molecular Biotechnology of Microbiological Systems. Biotechnological processes involving				Questions for the test

	recombinant microorganisms.				
7	Topic 7. Medicine and immunobiotechnology. Microbiological production of medicines.	PC-2.3 Able to analyze the results of an experiment in the field of biotechnology and bioengineering and carry out the development of medicines, medical devices, biomedical cell products and medical diagnostic systems	Knows Specifics of the development of medicines, medical devices, biomedical cell products and medical diagnostic systems. Can analyze the results of an experiment in the field of biotechnology and bioengineering Owns skills in the development of medicines, medical devices, biomedical cell products and medical diagnostic systems.	Colloquium	Questions for the test
8	Topic 8. Vaccine. Molecular diagnostics.			Colloquium	Questions for the test
9	Topic 9. Use of recombinant microorganisms to obtain commercial products for various purposes. Biodegradation of toxic compounds and utilization of biomass.			Oral Questioning	Questions for the test
10	Topic 10. Agriculture and ecology. Bacteria that stimulate plant growth. Microbial insecticides.	PC-2.4 Able to transfer the results of research work in the field of biotechnology and bioengineering for the development and production of medicines, medical devices, biomedical cell products and medical diagnostic systems	Knows Specifics of the development of medicines, medical devices, biomedical cell products and medical diagnostic systems. Can to transfer the results of research work in the field of biotechnology and bioengineering. Owns skills in the development of medicines, medical devices, biomedical cell products and medical diagnostic systems.	Oral Questioning	Questions for the test
11	Topic 11. Molecular biotechnology of eukaryotic systems. Gene Plant Engineering: Methodology and Application. Transgenic animals.			Colloquium	Questions for the test
12	Topic 12. Human Molecular Genetics. Gene therapy.			Test	Questions for the test

VIII. LIST OF REFERENCES AND INFORMATIONAL AND METHODOLOGICAL SUPPORT OF THE DISCIPLINE

Reference citations

1. Aleshina E.S., Drozdova E.A., Romanenko N.A. Kulturovanie mikroorganismov kak osnova biotekhnologicheskogo protsessa [Cultivation of microorganisms as the basis of the biotechnological process]. Text data. Orenburg: Orenburg State University, EBS ASV, 2017. – 192 p. – Mode of access: http://www.iprbookshop.ru/71282.html. – EBS "IPRbooks"

2. Gorlenko, V.A. Scientific Foundations of Biotechnology. Part 1. Gorlenko V.A., Kutuzova N.M., Pyatunina S.K. Nanotechnologies in Biology [Elektronnyi resurs]: uchebnoe posobie [Nanotechnologies in biology]: textbook / V.A. Gorlenko, N.M. Kutuzova, S.K. Pyatunina. –Electron. Text data. Moscow, Prometey Publ., 2013. – 262 p. – Mode of access: http://www.iprbookshop.ru/24003.html. – EBS «IPRbooks»

1. Lukanin, A.V. Inzhenernaya biotekhnologiya: osnovy tekhnologii mikrobiologicheskikh proizvodstva: Uchebnoe posobie [Engineering biotechnology: fundamentals of microbiological production technology: Textbook] / A.V. Lukanin – M.:NITZ INFRA-M, 2016. – 304 p. – Mode of access: http://znanium.com/catalog/product/527386

2. Lukanin, A.V. Inzhenernaya biotekhnologiya: osnovy tekhnologii mikrobiologicheskikh proizvodstva [Engineering biotechnology: fundamentals of microbiological production technology]. Textbook / A.V. Lukanin. Moscow, INFRA-M Publ., 2017. – 304 p. – Mode of access: http://znanium.com/catalog/product/768026

3. Lukanin, A.V. Inzhenernaya biotekhnologiya: protsessy i apparaty mikrobiologicheskikh proizvodstva [Engineering biotechnology: processes and apparatus of microbiological production]. Textbook / A.V. Lukanin. Moscow, INFRA-M Publ., 2018. – 451 p. – Mode of access: http://znanium.com/catalog/product/961375

3. Makhmutkin V.A., Tanaeva N.I. Obshchaya i pharmaceuticalnaya biotekhnologiya [General and pharmaceutical biotechnology]: textbook / compiled by V. A. Makhmutkin, N. I. Tanaeva. –Electron. textual data.— Samara: REAVIZ, 2009. – 118 p. – Mode of access: http://www.iprbookshop.ru/10164.html. – EBS "IPRbooks"

4. Orekhov, S.N. Pharmaceutical Biotechnology Guide to Practical Classes: Textbook. [Electronic resource] / S.N. Orekhov, ed. by V.A. Bykov, A.V. Katlinsky – Moscow: GEOTAR-Media, 2013. – 384 p. – mode of access http://www.studentlibrary.ru/book/ISBN9785970424995.html

5. Sazykin Yu.O., Orekhov S.N., Chakaleva I.I.; Ed. by A.V. Katlinsky – Moscow: Akademiya, 2014. 282 p. http://lib.dvfu.ru:8080/lib/item?id=chamo:785446&theme=FEFU

6. Sirotkin A.S., Zhukova V.B. Teoreticheskie osnovy biotekhnologii [Theoretical foundations of biotechnology]. –Electron. Text data. Kazan: Kazan National Research Technological University, 2010. – 87 p. – Mode of access: http://www.iprbookshop.ru/63475.html. – EBS "IPRbooks"

Further reading

1. Stem Cell Biology and Cell Technologies: for Medical Universities in 2 vols.: v.1 / M.A. Paltsev, R.S. Akchurin, M.A. Aleksandrova [et al.]; edited by M.A. Paltsev. Moscow: Meditsina, Shiko, 2009. 272 p. (in Russian). http://lib.dvfu.ru:8080/lib/item?id=chamo:779352&theme=FEFU

2. Stem Cell Biology and Cell Technologies: for Medical Universities in 2 vols.: v.2 / M.A. Paltsev, R.S. Akchurin, M.A. Aleksandrova [et al.]; edited by M.A. Paltsev. Moscow: Meditsina, Shiko, 2009. 455 p. (in Russian). http://lib.dvfu.ru:8080/lib/item?id=chamo:779355&theme=FEFU

3. Theoretical and Practical Aspects of the Use of Biotechnology and Genetic Engineering [Elektronnyi resurs]: uchebnoe posobie / G.V. Maksimov, V.N. Vasilenko, A.I. Klimenko [i dr.]. –Electron. Text data. Saratov: IPR Media, 2018. – 471 c. http://www.iprbookshop.ru/73635.html

4. Firsov G.M., Akimova S.A. Virology and Biotechnology: Textbook / G.M. Firsov, S.A. Akimova – 2nd ed., supplemented – Volgograd: Volgograd State Agrarian University, 2015. – 232 p. – Mode of access: http://znanium.com/catalog/product/615175

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/ - ЭБС "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; программа-библитекарь.

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 is a free file archiver with a high 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 DJV and DjVu formats of the same name; 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

A lecture is the main active form of classroom classes, an 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 of the 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 "Molecular Biotechnology", 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

in the course of 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 the laboratory lesson, students perform one or more laboratory works (tasks) under the guidance of the 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, 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 they are carried out, 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.

A detailed conversation involves the preparation of students for 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 tasks – situations (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 competencies aimed at solving various life and industrial situations (the use of the case involves individual and group work of students).

Brainstorming is a widely used way to generate 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.

X. LOGISTICAL SUPPORT OF DISCIPLINE

Training sessions on the discipline are held in rooms equipped with appropriate equipment and software.

The list of logistical and software of the discipline is given in the table.

Logistical and software of the discipline

Name of special rooms and rooms for independent work	Equipment special rooms and rooms for self-study	List of licensed software. Details of the supporting document
690922, Primorsky Krai, Vladivostok, Russky Island, Saperny Peninsula, Ajax village, 10, aud. M 605	Multimedia audience: Экран с электроприводом 236*147 см Trim Screen Line; Проектор DLP, 3000 ANSI Lm, WXGA 1280x800, 2000:1 EW330U Mitsubishi; Подсистема специализированных креплений оборудования CORSA-2007 Tuarex; Подсистема видеокоммутации: матричный коммутатор DVI DXP 44 DVI Pro Extron; удлинитель DVI по витой паре DVI 201 Tx/Rx Extron; Подсистема аудиокоммутации и звукоусиления; акустическая система для потолочного монтажа SI 3CT LP Extron; цифровой аудиопроцессор DMP 44 LC Extron; расширение для контроллера управления IPL T CR48; беспроводные ЛВС для обучающихся обеспечены системой на базе точек доступа 802.11a/b/g/n 2x2 MIMO(2SS). 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-bit)+Win8.1Pro(64-bit), 1-1-1 Wty	-
690922, Primorsky Krai,	Multimedia audience:	-

Vladivostok, Russky Island, Saperny Peninsula, Ajax village, 10, aud. M 422	HP ProOne 400 G1 AiO 19.5" Intel Core i3-4130T 4GB DDR3-1600 SODIMM (1x4GB)500GB; Projection screen Projecta Elpro Electrol, 300x173 cm; Multimedia projector, Mitsubishi FD630U, 4000 ANSI Lumen, 1920x1080; Mortise interface with TLS TAM 201 Stan automatic cable retraction; Avervision CP355AF visualizer; Sennheiser EW 122 G3 UHF microphone lavalier radio system consisting of wireless microphone and receiver; Video conferencing codec LifeSizeExpress 220-Codeconly- Non-AES; Multipix MP-HD718 Network Video Camera; Two 47" Full HD LG M4716CCBA LCD panels; Audio switching and sound reinforcement subsystem; Centralized uninterrupted power supply	
690922, Primorsky Krai, Vladivostok, Russky Island, Saperny Peninsula, Ajax village, 10, aud. M 627	Light microscope Carl Zeiss GmbH Primo Star 3144014501 (13 pcs.); Light microscope with digital camera Altami BIO8 (2 pcs).	-
Computer class of the School of Biomedicine aud. M723, 15 workplaces	Motorized 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-bit)+Win8.1Pro(64-bit), 1-1-1 Wty	