Ministry of Agriculture of the Russian Federation
Federal State Budgetary Educational Institution
of Higher Education
"St. Petersburg State University of Veterinary Medicine"

APPROVED BY
Vice-Rector for Educational
Work and Youth Policy
_____ Sukhinin A.A.
June 27, 2025

Department of Microbiology, Virology and Immunology

EDUCATIONAL WORK PROGRAM

for the discipline

" BIOTECHNOLOGY"

The level of higher education
SPECIALIST COURSE

Specialty 36.05.01 Veterinary Medicine
Profile: «General clinical veterinary medicine»
Full-time education
Education starts in 2025

Reviewed and adopted
at the meeting of the department
on June 24, 2025.
Protocol No. 14

Head of the Department of Microbiology,
Virology and Immunology,
Doctor of Veterinary Medicine, Professor
_____ Sukhinin A.A.

Saint Petersburg
2025

1. GOALS AND OBJECTIVES OF THE DISCIPLINE

The main goal of the discipline "Biotechnology" is to give students theoretical knowledge and practical skills in the basic industrial methods of production of biological products, identification, isolation, separation, purification and design of biologically active substances, as well as the creation of new active forms of organisms, absent in nature.

To achieve this goal, it is necessary to solve the following tasks:

- familiarizing students with the nature and diversity of biotechnological processes, achievements of biotechnology in the field of veterinary medicine;
- study of the technology for obtaining industrial nutrient media for the cultivation of various microorganisms;
- study of conditions affecting the rate of microbiological processes, growth and development of microbial populations;
- optimization of the microbial process;
- developing practical skills in isolating production strains of microorganisms, their selection, storage, and use for the industrial production of vaccines and antigens;
- study of the technology for preparing therapeutic and diagnostic serums and gamma globulins, probiotics, antibiotics, enzymes, vitamins, etc.;
- study of the technology for obtaining recombinant DNA, genetically engineered vaccines and monoclonal antibodies and their use in veterinary medicine;
- study of methods of control, standardization and certification of biological products and certification of production lines;
- study of the devices of the main production equipment for the preparation of nutrient media and dosage forms of drugs; familiarization with the divisions of biological enterprises, organization and management of biological production using modern electronic technology;
- study of promising and environmentally friendly technological processes based on the use of microorganisms.

2. LIST OF PLANNED LEARNING RESULTS IN THE DISCIPLINE (MODULE), CORRELATED WITH THE PLANNED RESULTS OF MASTERING THE EDUCATIONAL PROGRAM

As a result of mastering the discipline, the student prepares for the following types of activities, in accordance with the educational standard of Federal State Educational Standard of Higher Education 36.05.01 “Veterinary Medicine”.

Area of professional activity:
13 Agriculture

Types of professional activity tasks:
• Medical;
• Expert control
• Scientific and educational
Student competencies formed as a result of mastering the discipline

Studying the discipline should form the competence PC-5 - To carry out plan of animal treatment, based on the stated diagnosis and animals individual character ristics, signature of necessary remedies of chemical and biological nature for the treatment, taking into account combination of its pharmacological effect on the animal body. PC-5ID-7 - To know the pharmacological and toxicological characteristics of medicinal raw materials, remedies of chemical and biological nature, biologically active additives for the prevention and treatment of animal diseases of various etiology.

3. THE PLACE OF DISCIPLINE IN THE STRUCTURE OF THE MPEP

Discipline B1.V.02 “Biotechnology” is a part discipline formed by participants in

educational relations of the federal state educational standard of higher education in the specialty 36.05.01 “Veterinary Medicine” (specialty level).

Mastered in the 6th semester for full-time study.

When teaching the discipline "Biotechnology", the knowledge and skills acquired by students in mastering the disciplines of organic, inorganic, analytical and physical and colloidal chemistry, biological chemistry and physics, veterinary microbiology and mycology, genetics, physiology and anatomy of animals, pathological physiology of animals and pathological animal anatomy, clinical diagnostics.

Disciplines for which the discipline “Biotechnology” is a predecessor:

1) clinical diagnosis;
2) immunology;
3) pathological anatomy and forensic veterinary examination;
4) general and private surgery;
5) obstetrics and gynecology;
6) veterinary and sanitary examination;
7) epizootology and infectious diseases.

4. SCOPE OF THE DISCIPLINE “BIOTECHNOLOGY”

4.1. Scope of the discipline "Biotechnology" for full-time study

Type of educational work	Total hours	Semester 6
Classroom lessons (total)	**32**	**32**
Including:		
Lectures, including interactive forms	16	16
Practical lessons (PL), including interactive forms, including:	16	16
practical training (PT)	6	6
Independent work (total)	**40**	**40**
Type of intermediate certification (test, exam)	**Test**	**Test**
Total labor intensity hours	**72**	**72**
Credits	**2**	**2**

5. CONTENT OF THE DISCIPLINE “BIOTECHNOLOGY”
5.1. Contents of the discipline "Biotechnology" for full-time study

№	Name	Formed competencies	Semester	Виды учебной работы, включая самостоятельную работу студентов и трудоемкость (в часах)			
				L	PL	PT	IW
1.	Biotechnology as a science. Challenges and prospects of biotechnology in the 21st century. History of the creation of preventive drugs against infectious diseases (three periods). The latest methods of obtaining, transforming and improving food products Agricultural biotechnology. Industrial biotechnology human activity. Environmental biotechnology.	PC-5; ID-7	6	2	2		4
2.	Characteristics of production premises, equipment of structural divisions	PC-5; ID-7	6	2		2	4
3.	Microbial, plant, animal cells as the basis of modern biotechnology. Obtaining producers using genetic and cell engineering. Exo- and endometabolites as target products of biotechnology. The accumulation and processing of biomass is a method of obtaining cellular components. Obtaining exometabolites.	PC-5; ID-7	6	2	2	1	5
4.	Technology for the production of hydrolysates, extracts, infusions, as the basis for obtaining industrial nutrient media. Basic requirements for the production of nutrient media for microorganisms. Classification of nutrient media by purpose (simple, industrial, special).	PC-5; ID-7	6	2		1	5
5.	Deep and surface methods of cultivating microorganisms. The main stages of the technological process of deep cultivation of microorganisms in bioreactors (fermenters)	PC-5; ID-7	6	2			4
6.	Methods for isolating and concentrating biological products and products of microbial synthesis in product form (degree of purity and degree of concentration).	PC-5; ID-7	6				4
7.	Modern classification of vaccines. Technology for the production of live vaccines from artificially weakened strains. Methods for attenuation of virulent strains of microorganisms.	PC-5; ID-7	6	2	2		4
8.	Preparation of diagnostic immune sera, antigens, allergens, bacteriophages. Prescription of diagnostic drugs. Features of the preparation of erythrocyte diagnosticums.	PC-5; ID-7	6	2	2		4

9.	Biodegradation of agricultural waste. Recycling of solid and liquid waste using biomethanogenesis. Biological methods for treating wastewater and emissions. Bionanotechnology.	PC-5; ID-7	6	2	2	2	6
TOTAL FOR SEMESTER 6				**16**	**10**	**6**	**40**

6. LIST OF EDUCATIONAL AND METHODOLOGICAL SUPPORT FOR INDEPENDENT WORK OF STUDENTS

6.1. Guidelines for independent work

1. Pishchevaya biotekhnologiya : metodicheskie ukazaniya / A. A. Suhinin, V.O. Vinohodov ; MSKH RF, SPbGUVM. - Sankt-Peterburg : FGBOU VO SPbGUVM, 2020. - 15 s. - Rezhim dostupa: dlya avtoriz. pol'zovatelej EB SPbGUVM. URL: https://search.spbguvm.informsystema.ru/viewer.jsp?aWQ9NDE5JnBzPTE1 (date of access: 24.06.2025) - Tekst : elektronnyj.

6.2. Literature for independent work

1. Biotekhnologiya biopreparatov : metodicheskie ukazaniya / A. A. Suhinin, V.O. Vinohodov ; MSKH RF, SPbGUVM. - Sankt-Peterburg : FGBOU VO SPbGUVM, 2020. - 15 s. - Rezhim dostupa: dlya avtoriz. pol'zovatelej EB SPbGUVM. URL: https://search.spbguvm.informsystema.ru/viewer.jsp?aWQ9NDE4JnBzPTE1 (date of access: 24.06.2025) - Tekst : elektronnyj.

7. LIST OF BASIC AND ADDITIONAL LITERATURE REQUIRED FOR MASTERING THE DISCIPLINE “BIOTECHNOLOGY”

a) basic literature:

2) Obshchaya biotekhnologiya : uchebnik / V. O. Vinohodov, D. O. Vinohodov, M. V. Vinohodova ; pod obshch. red. A. A. Suhinina; MSKH RF, SPbGUVM. - Sankt-Peterburg : Izd-vo VVM, 2022. - 156 s. - Tekst (vizual'nyj) : neposredstvennyj.

8. LIST OF RESOURCES OF THE INTERNET INFORMATION AND TELECOMMUNICATION NETWORK NECESSARY FOR MASTERING THE DISCIPLINE “BIOTECHNOLOGY”

1. http://www.biotechnolog.ru/
2. https://meduniver.com – Medical information site.
3. http://www.cellbiol.ru/
4. http://www.mobot.org/MOBOT/Research/APweb/
5. http://animaldiversity.ummz.umi ch.edu/site/index.html
6. http://www.bio-economy.ru/
7. http://www.genetika.ru/journal/
8. http://www.biomos.ru/.

Electronic library systems:

1. EBS "SPBGUVM"
2. Legal reference system “ConsultantPlus”
3. University information system “RUSSIA”
4. Full-text database POLPRED.COM
5. Scientific electronic library ELIBRARY.RU

6. Russian Scientific Network
7. Electronic library system IQlib
8. Electronic books from the publishing house “Prospekt Nauki” http://prospektnauki.ru/ebooks/
9. Collection “Agriculture. Veterinary" publishing house "Kvadro" http://www.iprbookshop.ru/586.html
10. http://www.medliter.ru/ – electronic medical library.
11. www.4medic.ru - information portal for doctors and students.

9. METHODOLOGICAL INSTRUCTIONS FOR STUDENTS IN MASTERING THE DISCIPLINE “BIOTECHNOLOGY”

Methodological recommendations for students are a set of recommendations and explanations that allow the student to optimally organize the process of studying this discipline.

The content of methodological recommendations, as a rule, may include:

• Tips for planning and organizing the time needed to study the discipline. Description of the sequence of student actions, or “scenario for studying the discipline.”

The morning time is the most fruitful for educational work (from 8-14 o'clock), then the afternoon (from 16-19 o'clock) and the evening time (from 20-24 o'clock). The most difficult material is recommended to be studied at the beginning of each time interval after rest. After 1.5 hours of work, a break (10-15 minutes) is required; after 4 hours of work, the break should be 1 hour. Part of the scientific organization of labor is mastering the technique of mental work. Normally, a student should devote about 10 hours a day to studying (6 hours at the university, 4 hours at home).

• Recommendations for working on lecture material

When preparing for a lecture, the student is recommended to:

1) review the recordings of the previous lecture and recall previously studied material in memory;

2) it is useful to review the upcoming material of the future lecture;

3) if independent study of individual fragments of the topic of the last lecture is assigned, then it must be completed without delay;

4) prepare yourself psychologically for the lecture.

This work includes two main stages: taking notes of lectures and subsequent work on lecture material.

Note-taking means drawing up notes, i.e. a brief written statement of the content of something (oral presentation - speech, lecture, report, etc. or a written source - document, article, book, etc.).

The method of work when taking notes on oral presentations differs significantly from the method of work when taking notes from written sources.

By taking notes from written sources, the student has the opportunity to repeatedly read the desired passage of text, reflect on it, highlight the main thoughts of the author, briefly formulate them, and then write them down. If necessary, he can also note his attitude to this point of view. While listening to a lecture, the student must put off most of the above-mentioned work for another time, trying to use every minute to record the lecture, and not to comprehend it - there is no time left for this. Therefore, when taking notes from a lecture, it is recommended to separate fields on each page for subsequent entries in addition to the notes.

After recording a lecture or taking notes, you should not leave work on the lecture material until you begin preparing for the test. It is necessary to do as early as possible the work that accompanies note-taking of written sources and which was not possible to do while recording the lecture - read your notes, deciphering individual abbreviations, analyze the text, establish logical connections between its elements, in some cases show them graphically,

highlight main thoughts, note issues that require additional processing, in particular, teacher consultation.

When working on the text of a lecture, the student needs to pay special attention to the problematic questions posed by the teacher when giving the lecture, as well as to his assignments and recommendations.

For each lecture, practical lesson and laboratory work, a number is given, etc.

Recommendations for preparing for practical classes

Practical (seminar) classes constitute an important part of students' professional training. The main goal of conducting practical (seminar) classes is to develop analytical, creative thinking in students by acquiring practical skills. Practical classes are also conducted with the aim of deepening and consolidating the knowledge gained at lectures and in the process of independent work on regulatory documents, educational and scientific literature. When preparing for a practical lesson for students, it is necessary to study or repeat theoretical material on a given topic.

When preparing for a practical lesson, the student is recommended to adhere to the following algorithm;

1) get acquainted with the plan of the upcoming lesson;

2) study the literature sources that were recommended and familiarize yourself with the introductory comments to the relevant sections.

Methodological instructions for practical (seminar) classes in the discipline, along with the work program and schedule of the educational process, refer to methodological documents that determine the level of organization and quality of the educational process.

The content of practical (seminar) classes is recorded in the working curriculum of the disciplines in the sections "List of topics for practical (seminar) classes."

The most important component of any form of practical training is assignments. The basis of the assignment is an example, which is analyzed from the perspective of the theory developed in the lecture. As a rule, the main attention is paid to the formation of specific skills and abilities, which determines the content of students' activities - problem solving, laboratory work, clarification of the categories and concepts of science, which are a prerequisite for correct thinking and speech.

Practical (seminar) classes perform the following tasks:

- stimulate regular study of recommended literature, as well as attentive attention to the lecture course;
- consolidate the knowledge gained in the process of lecture training and independent work on literature;
- expand the scope of professionally significant knowledge, skills and abilities;
- allow you to check the correctness of previously acquired knowledge;
- instill skills of independent thinking and oral presentation;
- promote free use of terminology;
- provide the teacher with the opportunity to systematically monitor the level of students' independent work.

Methodological instructions for practical (seminar) classes in the discipline should be focused on modern business conditions, current regulatory documents, advanced technologies, on the latest achievements of science, technology and practice, on modern ideas about certain phenomena and the reality being studied.

Laboratory work constitutes an important part of students' professional training. They are aimed at experimental confirmation of theoretical principles and the formation of educational and professional practical skills.

Students' performance of laboratory work is aimed at:

- generalization, systematization, deepening, consolidation of acquired theoretical knowledge on specific topics of disciplines;
- formation of necessary professional skills and abilities;

The disciplines for which laboratory work is planned and their volumes are determined by the working curriculum.

Guidelines for conducting laboratory work are developed for the duration of the working curriculum and include:

- title, which indicates the type of work (laboratory), its serial number, volume in hours and name;
- Objective;
- subject and content of the work;
- equipment, technical means, tools;
- order (sequence) of work execution;
- safety and labor protection rules for this work (if necessary);
- general rules for the design of work;
- Control questions;
- tasks;
- list of references (if necessary).

The content of laboratory work is recorded in the working curriculum of the disciplines in the section “List of topics for laboratory work.”

When planning laboratory work, it should be taken into account that, along with the leading goal - confirmation of theoretical principles - in the course of completing tasks, students develop practical skills and skills in handling laboratory equipment, equipment, etc., which can form part of professional practical training, as well as research skills (observe, compare, analyze, establish dependencies, draw conclusions and generalizations, independently conduct research, document the results).

The composition of tasks for laboratory work should be planned in such a way that they can be completed efficiently by the majority of students in the allotted time.

Laboratory work as a type of educational activity should be carried out in specially equipped educational laboratories. The necessary structural elements of laboratory work, in addition to the independent activity of students, are instructions given by the teacher, as well as the organization of a discussion of the results of the laboratory work.

The completion of laboratory work is preceded by testing students' knowledge - their theoretical readiness to complete the task.

• Recommendations for working with literature.

Working with literature is an important stage of a student’s independent work in mastering a subject, contributing not only to consolidation of knowledge, but also to broadening his horizons, mental abilities, memory, ability to think, present and confirm his hypotheses and ideas. In addition, research skills necessary for future professional activities are developed.

When starting to study literature on a topic, it is necessary to make notes, extracts, and notes. It is imperative to take notes on the works of theorists, which allow one to comprehend the theoretical basis of the study. For the rest, we can limit ourselves to extracts from studied sources. All extracts and quotations must have an exact “return address” (author, title of work, year of publication, page, etc.). It is advisable to write an abbreviated name of the question to which the extract or quotation relates. In addition, it is necessary to learn how to immediately compile a card index of specialized literature and publications of sources, both proposed by the teacher and identified independently, as well as refer to bibliographic reference books, chronicles of journal articles, book chronicles, and abstract journals. In this case, publications of sources (articles, book titles, etc.) should be written on separate cards, which must be filled out in accordance with the rules of bibliographic description (surname, initials of the author, title of work. Place of publication, publisher, year of publication, number of pages, and for journals articles – journal name, year of publication, page numbers). On each card, it is advisable to record the thought of the author of the book or a fact from this book on only one specific issue. If the work, even in the same paragraph or phrase, contains further judgments

or facts on another issue, then they should be written out on a separate card. The presentation should be concise, accurate, without subjective assessments. On the back of the card you can make your own notes about this book or article, its contents, structure, what sources it was written on, etc.

• Explanations about working with test materials for the course, recommendations for completing homework.

Testing allows you to determine whether the actual behavior of the program corresponds to the expected behavior by performing a specially selected set of tests. A test is the fulfillment of certain conditions and actions necessary to verify the operation of the function being tested or its part. Each question in the discipline must be answered correctly by choosing one option.

• Recommendations for completing course work (if it is included in the curriculum), defining their thematic focus, goals and objectives of implementation, requirements for content, volume, design and organization of management of their preparation on the part of departments and teachers.

According to the guidelines presented in the list of guidelines.

10. EDUCATIONAL WORK

As part of the implementation of the discipline, educational work is carried out to form a modern scientific worldview and a system of basic values, the formation and development of spiritual, moral, civil and patriotic values, a system of aesthetic and ethical knowledge and values, attitudes of tolerant consciousness in society, the formation in students of the need to work as the first vital necessity, the highest value and the main way to achieve success in life, to understand the social significance of your future profession.

11. LIST OF INFORMATION TECHNOLOGIES USED IN THE EDUCATIONAL PROCESS

11.1. Information Technology:

The educational process in the discipline provides for the use of information technologies:

 lecturing using slide presentations;

 interactive technologies (conducting lectures, dialogues, collective discussion of various approaches to solving a particular educational and professional problem);

 interaction with students via email;

 collaboration in the Electronic Information and Educational Environment of St. Petersburg State University of Computer Science: https://spbguvm.ru/academy/eios/

11.2 Software:

List of licensed and freely distributed software, including domestically produced ones

№	Name of technical and computer training aids recommended by sections and topics of the program	License
1	MS PowerPoint	67580828
2	LibreOffice	free software
3	ОС Альт Образование 8	ААО.0022.00
4	АБИС "МАРК-SQL"	02202014155
5	MS Windows 10	67580828
6	System ConsultantPlus	503/КЛ
7	Android ОС	free software

12. MATERIAL AND TECHNICAL BASE REQUIRED FOR THE IMPLEMENTATION OF THE EDUCATIONAL PROCESS IN THE DISCIPLINE "BIOTECHNOLOGY"

Name of the discipline (module), practice in accordance with the curriculum	Name of special premises and premises for independent work	Equipping special rooms and rooms for independent work
Discipline B1.V.02 "Biotechnology"	**412** (196084, St. Petersburg, Chernigovskaya st., 5) Classroom for conducting seminar-type classes, group and individual consultations, ongoing monitoring and intermediate certification.	*Specialized furniture: tables, chairs, boards, illustrative material in the form of computer presentations, posters, demonstration material on topics.* *Technical teaching aids: laptop, projector, screen, electrical connector for Internet access.* *Laboratory tables medical laboratory metal cabinet, homogenizer, universal pH meter, comparator (Michaelis apparatus), magnetic stirrer, UV lamp, slides and cover glasses, alcohol burners, loop tank, tweezers, dye solutions, immersion oil rinse with bridges, containers with disinfectants, laboratory mixing device, biothermostat, Krotov apparatus, desiccator, microanaerostat, hot air sterilizers of two different types, fume hood, water bath.*
	422 (196084, St. Petersburg, Chernigovskaya st., 5) Classroom for conducting seminar-type classes, group and individual consultations, ongoing monitoring and intermediate certification.	*Specialized furniture: tables, chairs, boards, illustrative material in the form of computer presentations, posters, demonstration material on topics. Technical teaching aids: laptop, projector, screen.* *Laboratory tables, medical laboratory metal cabinet, portable UV lamp, slides and cover glasses, alcohol burners, loop tank, tweezers, dye solutions, immersion oil, rinses with bridges, containers with disinfectants, bottles for washing smears. Krotov apparatus, desiccator, microanaerostat, stands, test tubes with saline. solution. Device for filtration through ceramic candles, ceramic bacterial candles, microscopes, table lamps, electric extension cord, bacteriological bath.*
Discipline B1.V.02 "Biotechnology"	**423** (196084, St. Petersburg, Chernigovskaya st., 5) Classroom for conducting seminar-type classes, group and individual consultations, ongoing monitoring and intermediate certification.	*Specialized furniture: tables, chairs, boards, illustrative material in the form of computer presentations, posters, demonstration material on topics. Technical teaching aids: laptop, projector.* *Laboratory tables, a medical laboratory metal cabinet, a dry air sterilizer, microscopes, a Koch apparatus, a water bath, a thermostat, slides and cover glasses, alcohol burners, a loop tank, tweezers, dye solutions, immersion oil rinsers with bridges, containers with disinfectant solutions, a homogenizer, a thermostat.*
	424 (196084, St. Petersburg, Chernigovskaya st., 5) Classroom for conducting seminar-type classes, group and individual consultations, ongoing monitoring and intermediate certification.	*Specialized furniture: tables, chairs, boards, illustrative material in the form of computer presentations, posters, demonstration material on topics. Technical teaching aids: laptop, projector.* *Laboratory benches, scales, centrifuge, homogenizer, Ph - meter, magnetic stirrer, electric dry-air thermostat, laminar flow box, heating mantle, portable UV lamp, fluorescent microscope, medical laboratory metal cabinet, dry-air sterilizer,*

		microscopes, slides and cover glasses, alcohol burners, loop tank, tweezers, coloring solutions, immersion oil rinser with bridges, containers with disinfectant solutions, homogenizer, thermostat.
	417 room for equipment storage and preventative maintenance.	*Laboratory tables, chairs, medical laboratory metal cabinet, iron cabinet (safe), household refrigerator, TS-80 thermostat, microscopes, centrifuge, laboratory cabinets.*
	422 room for equipment storage and preventative maintenance.	*Composite cabinet, desks -2, executive table, chairs, household refrigerator, laboratory table, medical glass cabinet.*
	206 Large reading room (196084, St. Petersburg, Chernigovskaya str., building 5) Room for independent work	*Specialized furniture: tables, chairs* *Technical teaching aids: computers with an Internet connection and access to the electronic information and educational environment*
	224 Small reading room (196084, St. Petersburg, Chernigovskaya str., building 5) Room for independent work	*Specialized furniture: tables, chairs* *Technical teaching aids: computers with an Internet connection and access to the electronic information and educational environment*
	324 Information Technology Department (196084, St. Petersburg, Chernigovskaya str., building 5) Room for storage and preventive maintenance of educational equipment	*Specialized furniture: tables, chairs, special equipment, materials and spare parts for preventive maintenance of educational equipment*
	Box No. 3 Carpentry workshop (196084, St. Petersburg Chernigovskaya str., building 5)	*Petersburg, st. Chernigovskaya, house 5) Room for storage and preventive maintenance of educational equipment. Specialized furniture: tables, chairs, special equipment, materials for preventive maintenance of furniture.*

Developer:

Associate Professor, Department of Microbiology, Virology and Immunology, Candidate of Veterinary Sciences _____ V.O. Vinokhodov

Annex 1

Ministry of Agriculture of the Russian Federation
Federal State Budgetary Educational Institution
of higher education
"Saint Petersburg State University of Veterinary Medicine"

Department of microbiology, virology and immunology

FUND OF ASSESMENT TOOLS
for the discipline

BIOTECHNOLOGY

Level of higher education
SPECIALIST COURSE

Specialty 36.05.01 Veterinary Medicine
Profile: «General clinical veterinary medicine»
Full-time education

Education starts in 2025

Saint Petersburg
2025

1. PASSPORT OF THE ASSESSMENT FUND

Table 1 №	Formable competencies	Controlled sections (topics) of the discipline	Assessment tool
1.	PC-5 ID-7	Biotechnology as a science. Challenges and prospects of biotechnology in the 21st century. Biotechnology of preventive drugs. Agricultural, industrial, environmental biotechnology.	Colloquium, tests
2.		Engineering and technical support of biotechnological processes.	Colloquium, tests
3.		Producers and target products. Characteristics of the stages of the biotechnological process.	Colloquium, tests
4.		Substrates and media for biotechnological production. Classification, preparation, sterilization.	Colloquium, tests
5.		Methods for cultivating producers. Features of surface and deep cultivation.	Colloquium, tests
6.		Methods for isolating and concentrating target products (degree of purity and degree of concentration).	Colloquium, tests
7.		Technology for the production of live vaccines and inactivated vaccines against bacterial and viral infections. Methods for attenuation of virulent strains.	Colloquium, tests
8.		Preparation of diagnostic diagnostic preparations.	Colloquium, tests
9.		Biodegradation of agricultural waste. Recycling of solid and liquid waste using biomethanogenesis. Biological methods for treating wastewater and emissions. Bionanotechnology.	Colloquium, tests

2. SAMPLE LIST OF ASSESSMENT TOOLS

Table 2

№	Name evaluation tool	Brief description of the evaluation tool	Presentation of the assessment tool in the fund
1.	Colloquium	A means of monitoring the assimilation of educational material of a topic, section or sections of a discipline, organized as a training session in the form of an interview between a teacher and students	Questions on topics/sections of the discipline
2.	Test	A system of standardized tasks that allows you to automate the procedure measuring the level of knowledge and skills of the student	Test task fund

3. INDICATORS AND CRITERIA FOR ASSESSING COMPETENCIES AT VARIOUS STAGES OF THEIR FORMATION, DESCRIPTION OF ASSESSMENT SCALES

Table 3

Planned results of mastering the competency	Mastery level				Evaluation tool
	unsatisfactory	satisfactory	good	excellent	
Studying the discipline should form the competence PC-5 - Development of a treatment plan for animals based on the established diagnosis and individual characteristics of the animals, selection of the necessary drugs of a chemical and biological nature for the treatment of animals, taking into account their total pharmacological effect on the body. PC5-ID-7 - "Know the pharmacological and toxicological characteristics of medicinal raw materials, drugs of a chemical and biological nature, biologically active additives for the prevention and treatment of animal diseases of various etiologies."					
KNOW: pharmacological and toxicological characteristics of medicinal raw materials, drugs of chemical and biological nature, biologically active additives for the prevention and treatment of animal diseases of various etiologies	The level of knowledge is below the minimum requirements, there were serious errors	Minimum acceptable level of knowledge, many minor mistakes were made	The level of knowledge corresponds to the training program, several minor mistakes were made	The level of knowledge corresponds to the training program, without errors.	Colloquium, tests

3. LIST OF CHECK TASKS AND OTHER MATERIALS REQUIRED FOR THE ASSESSMENT OF KNOWLEDGE, ABILITIES, SKILLS AND ACTIVITY EXPERIENCE

3.1. Typical tasks for ongoing progress monitoring

3.1.1. Questions for the colloquium

Questions to assess the competence of PC-5: «To carry out plan of animal treatment, based on the stated diagnosis and animal individual characteristics, signature of necessary remedies of chemical and biological nature for the treatment, taking into account combination of its pharmacological effect on the animal body». ID-7; PC-5: «**To know** the pharmacological and toxicological characteristics of medicinal raw materials, remedies of chemical and biological nature, biologically active additives for the prevention and treatment of animal diseases of various etiology».

Sources of obtaining industrial strains of producers. Taxonomic groups of producers.

1. Requirements for producers of BT processes. Microorganisms GRAS.
2. Brief description of the stages of the biotechnological process.
3. Requirements for fermenters for industrial cultivation of producers.
4. Characteristics of bioreactors by type of mixing and aeration.
5. System of heat exchange, defoaming, control and management of cultivation processes in bioreactors?
6. How is the bioreactor, air and nutrient media sterilized in preparation for industrial cultivation?
7. The main components of nutrient media for the cultivation of producers. Characterize microorganisms based on the type of carbon and nitrogen nutrition.
8. Principles of designing nutrient media. How is the composition of the nutrient medium selected for each type of producer? How is the quality of software assessed?
9. Characterize raw materials sources of plant and animal origin, as well as from production waste for constructing nutrient media.
10. What is meant by standardization and how is standardization ensured when designing a software system?
11. Storage and maintenance of production strains. Preparation of a seed (mother) culture of a producer for a biotechnological process?
12. Give a classification of methods and processes for cultivating producers. Characteristics of solid phase and liquid phase cultivation.
13. Batch cultivation. Characteristics of producer growth phases and synthesis of target products.
14. Chemostat and turbidostat cultivation modes. Characteristics of continuous cultivation.
15. Determination of the concentration of producer cells during cultivation.
16. Characteristics of the preparatory stage of BTP.
17. Methods for separating culture liquid and biomass?
18. Methods for isolating the target product from a solution after cell disintegration.
19. Methods for purification of target products.
20. Treatment of wastewater and emissions. The value of activated sludge.
21. Methods for determining residual amounts of AMPs.
22. Anaerobic methods of waste processing. Microorganisms of anaerobic biocenoses.
23. Biogas plants. Stages of biomethanogenesis during waste processing.
24. Basic principles of organizing an enterprise for the production of biological products. Auxiliary and production areas.
25. Sanitation of a biological enterprise, quality control of disinfection of surfaces and equipment.

26. The essence and tasks of genetic engineering. Stages of obtaining genetically modified producing microorganisms.

27. Methods for obtaining genes for genetic engineering.

28. Requirements for genetic vectors.

29. Vectors for transfer of genetic information into prokaryotic and eukaryotic cells.

30. Principles of creating a genetic construct for introduction into cells based on a plasmid and bacteriophage.

31. Introduction of a genetic construct into the recipient organism.

32. Identification (screening) and selection of cells that have acquired the desired gene or genes.

33. Use of transgenic plants in the world and in Russia. Methods for detecting and identifying GMO components in feed and food products.

34. Quantitative determination of the content of GMO components in feed and products?

35. Methods of cultivating cell cultures in biotechnology (monolayer, roller and suspension).

36. Cultivation of cell cultures in a monolayer. Multilayer cultivation.

37. Features of suspension cultivation. Application of microcarriers.

38. Control of biological products during release?

39. Identification of markers of development of the resistance mechanism when selecting antibacterial drugs for treatment.

3.1.2. Test questions on the discipline "Biotechnology"

Questions to control the competence PC-5: «To carry out plan of animal treatment, based on the stated diagnosis and animal individual characteristics, signature of necessary remedies of chemical and biological nature for the treatment, taking into account combination of its pharmacological effect on the animal body». ID-7; PC-5: «**To know** the pharmacological and toxicological characteristics of medicinal raw materials, remedies of chemical and biological nature, biologically active additives for the prevention and treatment of animal diseases of various etiology».

CLOSED-TYPE TASKS

Test questions (select one correct answer)

Task 1. What is biotechnology:
A. The science of the nature and production of substances of biological origin;
B. The science of producing products necessary for humanity with the help of living organisms (producers);
C. The science of producing products necessary for humanity with the help of living organisms (producers) under controlled conditions of their cultivation;
D. An anti-scientific direction of human activity with the aim of modifying natural processes.
Key: B

Task 2. Which organism can be considered a producer:
A) Any organism capable of producing a biosynthetic product (goods);
B) Only that organism which in principle is not capable of producing a biosynthetic product (goods);
C) A certified strain, variety, breed, cross of an organism permitted by the State for industrial use on its territory;
D) Any organism that can be used to create biological weapons of mass destruction.
Key: B

Task 3. Why is biotechnology using microorganisms (bacteria and lower fungi) most widely developed?
A. Microorganisms are more productive than others;
B. Microorganisms have a minimum of limits for substances and energy. They can synthesize all the necessary substances themselves from the substrate;
C. Microorganisms easily take root in biotechnological equipment;
D. Microorganisms are resistant to changes in pH, osmotic and oncotic pressure in substrates during cultivation.
Key: B
Task 4. Which producer is most often used to produce citric acid?
A) Aspergillus niger;
B) Bacíllus ánthracis;
C) Chlamydophila psittaci.
Key: A

TO ESTABLISH A CONFORMITY

Task 5. Establish a correspondence between the laws of nature used in biotechnology.

Laws of Nature	The essence and purpose of use
1. What does the law of academician Mikhail Vasilyevich Lomonosov say?	a. Quantitative constancy of substances and energy in a limited volume.
2. What does the law of mass transfer in biotechnology say?	b. Describes the pattern and efficiency of transfer of substrate mass into the producer biomass or into the mass of the target product.
3. Why do biotechnologists need the law of Mono-Jerusalem?	c. Describes the pattern of growth of the producer population. Allows to predict the results of cultivation.
4. What does the law "Scheme of the biotechnological process" say?	d. Describes the mandatory sequence of stages of the biotechnological process.
5. What is the "Mass Effect" in biotechnology?	e. Unestablished pattern of development of some populations of organisms, depending on the volume and mass of cultivation.

Key: 1a2b3v4g5d

Task 6. Establish a correspondence between producers and biotechnological equipment for their cultivation.

Producers	Equipment and process lines
1. Bacteria and fungi	a. Automated bioreactors from 0.1 (pilot) to 350 t (m3, industrial).
2. Aquatic mollusks, arthropods, fish	b. Pools, ponds, including aerated and thermostatted.
3. Meat cross chickens	c. Poultry houses (broiler houses) 18 × 96 m with automatic maintenance of the cultivation process conditions for 38 days.
4. Bacon hybrid piglets	d. Fattening piggeries without walking areas with automatic maintenance of the cultivation process conditions.
5. Dairy cattle	e. Automated dairy complex for the production of

	milk 10.5 tons per day.

Key: 1a2b3c4d5e

CLOSED-TYPE TASKS FOR ESTABLISHING A SEQUENCE

Task 7. Match the scientist's surname with the discovery he made:

Scientist's surname	Discoveries made by scientists
1. A.V. Leeuwenhoek	A. Tobacco mosaic virus
2. L. Pasteur	B. Smallpox vaccine
3. E. Jenner	C. Vaccine against chicken cholera (pasteurellosis), swine erysipelas, rabies
4. D.I. Ivanovsky	D. Microscope

Key: 1-G; 2-V; 3-B; 4-A.

Task 8. Which definition corresponds to the biological function:

Definition	Biological function
1.Antibody	A) M; G; A; E; D.
2.Immunoglobulin	B) To the smallpox virus;
	C) To the rabies virus;
	D) To the causative agent of swine erysipelas

Key: 1-B, C, D; 2-A

TEST QUESTIONS (SELECT ONE CORRECT ANSWER)

Task 9. Match the sensors used in biotechnology to control the conditions and results of cultivation.

Sensors	Scope
1. Thermometer, autoclavable resistance thermometer	a. Monitoring and maintaining operating temperature during producer cultivation and measurements.
	b. Monitoring the ionic composition of liquid and gaseous substrates during cultivation, including for its correction.
	c. Monitoring the accumulation of target products in producer biomass.
	d. Monitoring the increase in the concentration of nucleic acids, proteins, and other biosynthetic products.
	e. Monitoring the amount of dry matter in liquid substrates or biomass.

Key: 1a

Task 10. Establish a correspondence between substrates and bacteria, fungi-producers of target biosynthesis products.

Substrates and media	Producers
1. Liquid sugar substrates, liquid nutrient media with glycosides	a. Cultivation of molds and yeasts, for example, for the biosynthesis of Krebs cycle acids.

	b. Isolation from materials and primary cultivation of animal pathogens, for example, mycoplasmas and pasteurella.
	c. Isolation and primary cultivation of bacteria of the Enterobacteriaceae family.
	d. Semi-industrial cultivation of molds, for example, for the production of β-carotene.
	e. Semi-industrial cultivation of higher fungi, for example, oyster mushrooms and honey fungi of summer and winter varieties.

Key: 1a

Task 11. Establish the correspondence between refrigeration equipment and methods for preserving biomass and other biosynthesis products.

Equipment	Purpose of use
1. Industrial refrigeration chambers with a storage temperature of +2 – +10 ºC.	a. Preservation and storage of chilled products, such as fresh meat, eggs, etc.
	b. Preservation, storage, and transportation of frozen products, such as fish.
	c. Preservation and storage of long-life products, including for subsequent lyophilization.
	d. Freezing organisms for long-term storage at -70°C, such as cell cultures.
	e. Long-term storage of genetically significant materials and organisms, such as sperm, eggs, early animal embryos, bacterial strains, viruses, etc.

Key: 1a

A COMBINED TYPE TASK WITH A CHOICE OF ONE OR MORE CORRECT ANSWERS FROM FOUR PROPOSED ANSWERS AND A JUSTIFICATION OF THE CHOICE

Task 12. Establish a correspondence between biosynthetic products and the methods traditionally used for their preservation.

Producers	Preservation Methods
1. Biomass of bacteria, molds, and yeasts grown on liquid substrates	a. Cooling, freezing, acidification, chemical preservation, freeze-drying.
2. Biomass (suspension) of viruses grown on embryos or in animal cell cultures	b. Cooling, freezing, chemical preservation, sterilizing filtration, freeze-drying.
3. Liquid hyperimmune serums against animal diseases	c. Cooling, chemical preservation, sterilizing filtration.
4. Vegetable and fruit juices, essences, gels, pastes, etc.	d. Evaporation and production of 10-fold concentrates, chemical preservation.
5. Fresh fruits, vegetables, and edible green parts of plants	e. Cooling, canning, including freeze-drying.

Key: 1a2b3c4d5e

JUSTIFICATION OF CHOICE: Standard (GOST) technologies for the preservation and storage of biological synthesis products.

Task 13. Establish the correspondence between the technological processes of rough cleaning and biotechnological methods for achieving the production goal.

Technological processes	Purification Methods
1. Clarification of beer, bringing it to a marketable condition	a. Clarifying filtration through filters with pores <5 μm. Separation at 8,000 rpm.
2. Cleaning of barley grain from seeds of varietal grasses, such as rapeseed	b. Screening with calibrated sieves.
3. Purification of animal blood serum from immune complexes and other large protein conglomerates	c. Single freeze-thaw followed by draining of the clear portion of the whey under sterile conditions.
4. Removal of excess alkali metal salts and light acids from liquid substrates or liquid biomass	d. Product dialysis against distilled or deionized water.
5. Removal of dust from exhaust gas streams, such as air	e. Gas passage through an oil-filled air filter.

Key: 1a2b3c4d5e

JUSTIFICATION OF CHOICE: Standard (GOST) technologies for the production of the listed biological synthesis products.

Task 14. Establish the correspondence between the technological processes of fine purification and biotechnological methods for achieving the production goal.

Technological processes	Purification methods
1. Isolation of viruses for biomass and electron microscopic studies	a. Ultracentrifugation at 50,000 rpm or more, collection of precipitate containing viruses.
2. Isolation and concentration of citric acid from Aspergillus niger biomass	b. Precipitation with calcium hydroxide (milk of lime), separation with precipitation.
3. Extraction of albumin, non-specific IgG, IgM, and other antibodies from blood serum	c. High-performance liquid chromatography with separate fraction collection.
4. Isolation of antibodies to Salmonella O9 antigen from hyperimmune serum	d. High-performance liquid affinity chromatography.
5. Production of deionized water with a resistivity of at least 10 MΩ/cm2	e. Ion exchange in a water stream through ion exchange resins: anion exchange resin, cation exchange resin.

Key: 1a2b3c4d5e

JUSTIFICATION OF CHOICE: Standard (GOST) technologies for purification and concentration of biological synthesis products.

Task 15. Establish the correspondence between quality indicators and technological methods of product quality control.

Monitored parameters	Research methods
1. pH of liquid substrates and biosynthetic products	a. Using indicator paper and pH-metry.
2. Transparency of liquid substrates and biosynthetic products	b. Organoleptically or by nephelometry.

3. Amount of protein and nucleic acids in liquid substrates and biosynthetic products	c. Spectrophotometrically at wavelengths of 280 and 260 nm, respectively.
4. Immunogenicity of vaccines and hyperimmune therapeutic sera	d. Vaccination of susceptible animals followed by infection with a virulent strain. Koch's triad.
5. Contamination control of live viral vaccines	e. Ultracentrifugation and examination of the sediment under an electron microscope.

Key: 1a2b3c4d5e

JUSTIFICATION OF CHOICE: Standard (GOST) technologies of State control of biological synthesis products, according to the technical specifications for their production.

Task 16. Establish a correspondence between biosynthesis products and methods of their pre-sale preparation (PSP).

Products	PPP Technologies
1. Crystalline citric acid, 98% (powder)	a. Packaging in kraft paper bags lined with polyethylene, labeled according to specifications.
2. Live virus vaccine against Newcastle disease, strain "H"	b. Packaging in penicillin vials, lyophilized, and stamped.
3. Anti-erysipelas serum (hyperimmune, therapeutic)	c. Packaging in 200 ml vials, labeled according to specifications.
4. Baker's yeast for retail sale to the public	d. Packaging in 20-pack paper bags with labels.
5. Bacillus thuringiensis spore suspension in freon for aerosol use	e. Packaging in labeled 50–200 ml aerosol cans.

Key: 1a2b3c4d5e

JUSTIFICATION OF CHOICE: Standard (GOST, TU) technologies for packaging, packing, and labeling of biological synthesis products.

OPEN-ENDED ASSIGNMENT

Task 17.
In biotechnology, a producer is….
Key: any organism capable of producing the target product of biosynthesis.

Task 18.
In biotechnology, a substrate is….
Key: an environment that orients the producer within the process space;

Task 19.
A bioreactor is….
Key: any apparatus, room, or confined space for the biosynthesis of target products.

Task 20.
Producer cultivation is…..
Key: the process of maintaining the producer in a confined space of the substrate under controlled conditions.

3.1.2 List of questions for students' independent work

Questions of independent work to assess the competence of PC-5: «To carry out plan of animal treatment, based on the stated diagnosis and animals individual character rustics, signature of necessary remedies of chemical and biological nature for the treatment, taking into account combination of its pharmacological effect on the animal body». ID-7; PC-5: «To know the pharmacological and toxicological characteristics of medicinal raw materials, remedies of chemical and biological nature, biologically active additives for the prevention and treatment of animal diseases of various etiology».

1. Describe the history of the development of the biotechnology industry over the past 40 years.
2. Why are so many different biosystems used in biotechnology?
3. How do prokaryotes differ from eukaryotes?
4. What are the main components of a liquid culture medium?
5. What is primary cell culture?
6. Sometimes the strategy for synthesizing a target protein involves producing it in the form of a chimeric protein. What is the advantage of this approach?
7. Describe the strategy for isolating the EcoRI restriction enzyme.
8. How can we increase the production of antibiotics by this strain of Streptomyces using genetic engineering?
9. How are enzymes used in industrial ethanol production?
10. How should the bacteria in the rumen of cows be modified to provide essential amino acids to cows?
11. What are the advantages of bioinsecticides over chemical insecticides?
12. Which parameters need to be strictly controlled when optimizing the fermentation process?
13. What concerns are associated with the development of genetic engineering?
14. How does the presence of a recombinant vaccine in a cell affect its growth?
15. What treatment is the cell suspension subjected to after fermentation is complete?
16. Which strategy would you use to purify recombinant protein secreted into the culture medium?
17. What are the advantages and disadvantages of mechanical destruction of cells compared to chemical destruction?
18. How do protease inhibitors protect plants from insects?
19. How can the mammary gland of an animal be used as a bioreactor for the production of target proteins?
20. How are the creation of genetically engineered organisms destined for release into the environment controlled?
21. How can patenting inventions influence the development of fundamental science?
22. Septic tanks, anaerobic biofilters for anaerobic wastewater treatment.
23. Bioremediation of gas-air emissions.
24. Biofilters, bioscrubbers and washed-bed bioreactors.
25. Draw up schemes for obtaining recombinant DNA and DNA cloning.
26. Draw up diagrams for diagnosing a viral disease using DNA probes.
27. Draw up schemes for producing interferon using genetic engineering.
28. Draw up schemes for obtaining DNA vaccines.
29. Draw up diagrams of the immune response in the animal’s body when DNA vaccines are administered.

3.1. Typical tasks for intermediate certification

3.2.1 Questions for testing

Competency being developed: PC-5: “To carry out plan of animal treatment, based on the stated diagnosis and animals individual character rustics, signature of necessary remedies of chemical and biological nature for the treatment, taking into account combination of its pharmacological effect on the animal body". ID-7; PC-5: “To know the pharmacological and toxicological characteristics of medicinal raw materials, remedies of chemical and biological nature, biologically active additives for the prevention and treatment of animal diseases of various etiology.”

1. Biotechnology: subject, sections, connections with other sciences, history of development.
2. Biological agents as elements of the biotechnological process.
3. Substrates and media as elements of the biotechnological process.
4. Equipment as an element of the biotechnological process.
5. Products of the biotechnological process.
6. Organization of the biotechnological process.
7. Biotechnology of waste processing. Biogas production.
8. Methods for treating wastewater and emissions.
9. Biotechnology for the production of live vaccines.
10. Biotechnology for the production of inactivated vaccines.
11. Biotechnology for the production of diagnostic and therapeutic serums.
12. Methods for purification and concentration of viruses.
13. Biotechnology for the production of antibiotics.
14. Microbiological methods for the production of amino acids.
15. Microbiological methods for the production of enzymes.
16. Applications and sources of enzymes.
17. Immobilized enzymes. Use in biotechnology.
18. Obtaining vitamins in a biotechnological process.
19. Biotechnological production of organic acids.
20. Types of cell and tissue cultures used in biotechnology.
21. Isolation and purification of enzyme preparations.
22. The use of cellular and genetic engineering in animal husbandry.
23. Genetic engineering method for producing insulin.
24. Genetic engineering method for producing interferon.
25. Methods for obtaining transgenic plants.
26. Types of plant cell and tissue cultures.
27. Plants are bioreactors of medicinal preparations.
28. Biotechnology for obtaining antigen and antibody erythrocyte diagnostics.
29. Biotechnology for producing allergens.
30. Biotechnology for obtaining bacteriophages.
31. Biotechnology for the production of lactic acid products.
32. Biotechnology for the production of microbial protein.

4. METHODOLOGICAL MATERIALS DETERMINING PROCEDURES FOR ASSESSING KNOWLEDGE, ABILITIES AND SKILLS AND ACTIVITY EXPERIENCE CHARACTERIZING THE STAGES OF COMPETENCY FORMATION

Criteria for assessing students’ knowledge during the colloquium:

• Mark “excellent” - the student clearly expresses his point of view on the issues under consideration, giving relevant examples.

• Mark “good” - the student makes some errors in the answer

• Mark “satisfactory” - the student reveals gaps in knowledge of the basic educational and

normative material.

• Mark “unsatisfactory” - the student reveals significant gaps in knowledge of the basic principles of the discipline, inability, with the help of the teacher, to obtain the correct solution to a specific practical problem.

Criteria for assessing students' knowledge during testing:

The test result is assessed on a percentage rating scale. Each student is offered a set of test tasks consisting of 25 questions:

• Mark “excellent” – 25-22 correct answers.

• Mark “good” – 22-18 correct answers.

• Mark “satisfactory” – 17-13 correct answers.

• Marked “unsatisfactory” – less than 13 correct answers

Knowledge criteria for the test:

• The “pass” grade must correspond to the parameters of any of the positive grades (“excellent”, “good”, “satisfactory”).

• A “failed” grade must meet the parameters of an “unsatisfactory” grade.

• Mark “excellent” – all types of academic work provided for by the curriculum have been completed. The student demonstrates the correspondence of knowledge, skills and abilities to the indicators given in the tables, operates with acquired knowledge, skills and abilities, and applies them in situations of increased complexity. In this case, inaccuracies and difficulties may occur during analytical operations and the transfer of knowledge and skills to new, non-standard situations.

• Mark “good” – all types of educational work provided for by the curriculum have been completed. The student demonstrates the correspondence of knowledge, skills and abilities to the indicators given in the tables, operates with acquired knowledge, skills and abilities, and applies them in standard situations. In this case, minor errors, inaccuracies, and difficulties during analytical operations and the transfer of knowledge and skills to new, non-standard situations may be made.

• Mark “satisfactory” – one or more types of academic work provided for by the curriculum have not been completed. The student demonstrates incomplete compliance of knowledge, abilities, skills with the indicators given in the tables, significant mistakes are made, a partial lack of knowledge, abilities, and skills is manifested in a number of indicators, the student experiences significant difficulties in operating knowledge and skills when transferring them to new situations. –

• Mark “unsatisfactory” – the types of educational work provided for by the curriculum have not been completed. Demonstrates incomplete compliance of knowledge, abilities, and skills with those given in the tables of indicators; significant mistakes are made; a lack of knowledge, abilities, and skills is evident in a larger number of indicators; the student experiences significant difficulties in operating knowledge and skills when transferring them to new situations

5. ACCESSIBILITY AND QUALITY OF EDUCATION FOR PERSONS WITH DISABILITIES

If necessary, disabled people and persons with limited health capabilities are given additional time to prepare an answer for the test.

When carrying out the procedure for assessing the learning outcomes of people with disabilities and people with limited health capabilities, their own technical means may be used.

The procedure for assessing the learning outcomes of people with disabilities and people with limited health capabilities in the discipline provides for the provision of information in forms adapted to the limitations of their health and perception of information:

For people with visual impairments:	– в печатной форме увеличенным шрифтом, – в форме электронного документа.
For people with hearing impairments:	– in printed form in enlarged font, – in the form of an electronic document.
For persons with musculoskeletal disorders	– in printed form, device: – in the form of an electronic document.

When carrying out the procedure for assessing the learning outcomes of disabled people and persons with limited health capabilities in the discipline, it ensures the fulfillment of the following additional requirements depending on the individual characteristics of the students:

a) instructions on the procedure for conducting the assessment procedure are provided in an accessible form (orally, in writing);

b) an accessible form for submitting assignments of assessment tools (in printed form, in printed form in enlarged font, in the form of an electronic document, assignments are read out by the teacher);

c) an accessible form of providing answers to assignments (written on paper, typing answers on a computer, orally).

If necessary, for students with disabilities and people with disabilities, the procedure for assessing learning outcomes in the discipline can be carried out in several stages.

The procedure for assessing the learning outcomes of disabled people and persons with limited health capabilities is permitted using distance learning technologies.