



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

AGREED  
Head of OP

(Signed) (Full name)



CLAIM  
Director of the Department of Medical Biology and  
Biotechnology

(Signed) (Acting Name)  
December 30, 2021

WORK PROGRAM OF THE DISCIPLINE  
Biomedical Cell Technologies  
Direction of training 06.04.01 Biology  
(Molecular and Cell Biology)  
Form of training: full-time

Course 1 semester 1  
lectures 18 h.  
practical exercises - hour.  
lab work 6 hours  
total hours of classroom load 36 hours.  
independent work 108 hours.  
including 45 hours to prepare for the exam.  
exam 1 semester

The work program is drawn up in accordance with the requirements of the Federal State Educational Standard in the direction of training 06.04.01 Biology, approved by the order of the Ministry of Science of the Republic of Russia dated 11.08.2020. № 934.

The work program was discussed at the meeting of the Department of Medical Biology and Biotechnology Protocol dated December 30, 2021 No. 5

Director of the Department of Implementing Structural Unit Ph.D., Associate Professor Kumeiko V.V.

Compiled by: Senior Lecturer A.S. Belousov

Vladivostok  
2021

Reverse side of the RPD cover page

1. The work program was revised at the meeting of the Department / department / department (implementing the discipline) and approved at the meeting of the Department / department / department (issuing structural unit), the protocol from " \_\_\_\_\_ № \_\_\_\_\_

2. The work program was revised at the meeting of the Department / department / department (implementing the discipline) and approved at the meeting of the Department / department / department (issuing structural unit), the protocol from " \_\_\_\_\_ № \_\_\_\_\_

3. The work program was revised at the meeting of the Department / Department / Department (implementing the discipline) and approved at the meeting of the Department / Department / Department (issuing structural unit), the protocol from " \_\_\_\_\_ № \_\_\_\_\_

4. The work program was revised at the meeting of the Department / Department / Department (implementing the discipline) and approved at the meeting of the Department / Department / Department (issuing structural unit), the protocol from " \_\_\_\_\_ № \_\_\_\_\_

5. The work program was revised at the meeting of the Department / Department / Department (implementing the discipline) and approved at the meeting of the Department / Department / Department (issuing structural unit), the protocol from " \_\_\_\_\_ № \_\_\_\_\_

## 1. Goals and objectives of mastering the discipline:

Purpose: To form competencies in the field of modern biomedical cell technologies, to develop the knowledge of students in the field of cell biology in culture, to teach the main modern methods of manipulating living cells and their application for the creation of cell products, biotechnological systems based on them and new biomedical technologies.

### Tasks:

1. Study of the theoretical foundations of cell biology in culture, provide knowledge about the basic growth needs of cells in culture, their proliferation and differentiation.

2. Mastery of the basic methods of cell culture, work with cells under aseptic conditions, preparation of nutrient media and additives, preparation of sterile materials and laboratory utensils, methods of obtaining primary cultures, obtaining clones and maintaining the viability of transplanted cell lines, methods of cryopreservation of cell cultures.

3. Mastering the basic principles and methods of analysis of cultured cells, assessment of viability, growth, proliferation and differentiation of cells in culture.

4. Mastering the basic skills of using cultured cells to create biotechnological systems for the production of targeted biologically active substances and new biomedical technologies, including technologies based on the use of stem cells and biocompatible materials in the creation of implantable tissue engineering structures for the needs of regenerative medicine.

## Professional competencies of graduates and indicators of their achievement:

| Task type | Code and name of professional competence (the result of mastery)  | Code and name of the competency achievement indicator   |
|-----------|---|---|
| research  | PC-1 Is able to creatively use in scientific and production-technological activities knowledge of fundamental and applied sections of disciplines (modules) that determine the scope of molecular and cell biology. | PC-1.1 Works with scientific and technical information and special literature, studies the achievements of domestic and foreign science in the field of molecular and cell biology using new technologies and electronic databases. |
|           |   | PC-1.2 Conceives and formulates diagnostic solutions to the problems of molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity               |
|           |   | PC-1.3 Uses in scientific and production-technological activities knowledge of fundamental and applied sections of disciplines that determine the scope of  |

|  |  |  |
|--|--|--|
|  |  | molecular and cellular biology   |
|  | PC-2 is able to apply the methodological foundations of design, perform laboratory biological, environmental research, use modern equipment and computing complexes in molecular and cell biology. | PC-2.1 Develops rules and algorithms for the design, implementation of laboratory biological and environmental research.   |
|  |  | PC-2.2 Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.   |
| PK-2.3 Applies the methodological foundations of design, laboratory biological, environmental research, uses modern equipment and computing complexes in molecular and cellular biology. |  |  |
|  | PC-3 is capable of conducting research on biopolymers, their components and complexes, the structure and function of genes and genomes.  | PC-3.1 Studies the structure and functions of biopolymers, their components and complexes, mechanisms of storage, transmission and implementation of genetic information at the molecular level.                             |
|  |  | PC-3.2 Detailedly characterizes the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, processing of RNA and proteins, protein folding and docking. |
|  |  | PC-3.3 The study of the main methods of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism.  |
|  |  | PC-3.4 Analyzes the structure and functions of genes and genomes, conducts structural and functional analysis of individual proteins and the proteome as a whole.  |

| Code and name of the competency achievement indicator   | Name of the assessment indicator (the result of training in the discipline)   |
|---|---|
| PC-1.1 Works with scientific and technical information and special literature, studies the achievements of domestic and foreign science in the field of molecular and cell biology using new technologies and electronic databases. | Knows the achievements of domestic and foreign science in the field of molecular and cell biology<br>Able to work with scientific and technical information and special literature in the field of molecular and cell biology using new technologies and electronic databases<br>He has the skills to work with scientific and technical information and special literature, including the use of new technologies and electronic databases.  |
| PC-1.2 Conceives and formulates diagnostic solutions to the problems of molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity               | Knows the actual problems of molecular and cell biology<br>Able to comprehend and formulate diagnostic solutions to the problems of molecular and cell biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity<br>Possesses the skills of comprehension and formulation of diagnostic solutions to the problems of molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity |
| PC-1.3 Uses in scientific and production-technological activities knowledge of fundamental and applied sections of disciplines that determine   | Knows the fundamental and applied sections of the disciplines that determine the scope of molecular and cellular biology<br>Able to use in scientific and production-technological activities knowledge of fundamental and applied sections of molecular  |

|  |   |
|--|---|
| the scope of molecular and cellular biology  | and cell biology<br>Possesses the skills of using in scientific and production-technological activities knowledge of fundamental and applied sections of molecular and cell biology   |
| PC-2.1 Develops rules and algorithms for the design, implementation of laboratory biological and environmental research.   | Knows the rules and algorithms of designing, performing laboratory biological, environmental studies<br>Able to develop rules and algorithms for designing, performing laboratory biological and environmental research.<br>Has the skills to design, perform laboratory biological, environmental research   |
| PC-2.2 Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.   | Knows the scientific methodological foundations of fundamental research<br>Able to perform laboratory biological, environmental research using the scientific methodological foundations of fundamental research<br>Has the skills and experience to perform laboratory biological and environmental research   |
| PK-2.3 Applies the methodological foundations of design, laboratory biological, environmental research, uses modern equipment and computing complexes in molecular and cellular biology.                                     | Knows the methodological foundations of design, laboratory biological, environmental research<br>Able to use modern equipment and computing complexes in molecular and cell biology<br>Possesses the skills of design, performing laboratory biological, environmental research using modern equipment and computer systems   |
| PC-3.1 Studies the structure and functions of biopolymers, their components and complexes, mechanisms of storage, transmission and implementation of genetic information at the molecular level.                             | Knows the structure and functions of biopolymers, their components and complexes, mechanisms for storing, transmitting and implementing genetic information at the molecular level<br>Able to investigate the structure and functions of biopolymers, their components and complexes, mechanisms for storing, transmitting and implementing genetic information at the molecular level<br>Possesses skills and methods for studying the structure and function of biopolymers, their components and complexes, mechanisms for storing, transmitting and implementing genetic information at the molecular level |
| PC-3.2 Detailedly characterizes the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, processing of RNA and proteins, protein folding and docking. | Knows the basic processes occurring in a living cell<br>Able to characterize in detail the main processes occurring in a living cell<br>Knowledge of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking  |
| PC-3.3 The study of the main methods of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism.  | Knows the main methods of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism<br>Able to investigate intermolecular interactions and mutual regulation of the processes of functioning of a living cell<br>Possesses the skills of studying intermolecular interactions and mutual regulation of the processes of functioning of a living cell in the composition of a multicellular organism  |
| PC-3.4 Analyzes the structure and functions of genes and genomes, conducts structural and functional analysis of individual proteins and the proteome as a whole.  | Knows the structure and function of genes and genomes, individual proteins and the proteome as a whole<br>Able to analyze the structure of the function of genes and genomes, proteins and proteomes<br>Proficient in the methods of analyzing the structure of the   |

|  |   |
|--|---|
|  | function of genes and genomes, proteins and the proteome as a whole |
|--|---|

1. Labor intensity of discipline and types of training sessions in the discipline

The total labor intensity of the discipline is 4 credited units (144 academic hours), (1 credit unit corresponds to 36 academic hours).

Types of training sessions and work of the student in the discipline are:

| Designation       | Types of training sessions and work of the student   |
|-------------------|--|
| Lek               | Lecture  |
| Lek electr.       |  |
| LR                | Labs   |
| Lr electr.        |  |
| WED:              | Independent work of the student during the period of theoretical training  |
| including control | Independent work of the student and contact work of the student with the teacher during the period of intermediate certification |

Structure of the discipline:

The form of training is full-time.

| №  | Name of the section<br>Discipline   | Se<br>me<br>ster | Number of hours by types of training sessions and work of the student |     |         |    |         |             | Intermediate attestation forms |
|----|---|------------------|---|-----|---------|----|---------|-------------|--------------------------------|
|    |   |                  | Lek   | Lab | Av<br>e | OK | WE<br>D | Cont<br>rol |                                |
| 1. | Section No1.<br>Purpose, objectives and theoretical foundations of biomedical cell technologies         | 1                | 10  | 8   | -       | -  | 30      | 20          | Interview                      |
| 2. | Section No2.<br>Prospects for the development and practical application of biomedical cell technologies | 1                | 8   | 10  | -       | -  | 33      | 25          | Test work                      |
|    | Total:  | 1                | 18  | 18  | -       | -  | 63      | 45          | Exam                           |

**THE STRUCTURE AND CONTENT OF THE THEORETICAL PART OF THE COURSE**

Lectures 18 hours.

**Section 1. Introduction. The purpose, objectives and theoretical foundations of biomedical cell technologies. (10 hours)**

**Topic 1. Introduction. The purpose and objectives of biomedical cell technologies. (2 hours).**

The concept of biomedical cell technologies. Possibilities of biomedical cell technologies. Brief historical information: A. Maksimov. L. Stevens. B. Mintz et al. Possibilities of using stem cells in the clinic. Stages of implementation in medical practice.

**Topic 2. Theoretical foundations of biomedical cell technologies. (4 hours).**

Principles of stem cell differentiation. Stem cell niche. Molecular bases of pluripotency. Mechanisms of stem cell renewal. Regional stem cells. Varieties of stem cells. Embryonic stem cell (ESC). Stem hematopoietic cell. Stem cells from the blood of the umbilical cord. Stem mesenchymal cell. Directed differentiation of stem cells. Stem cell transplantation in order to compensate for a genetic defect. Legislation and bioethical aspects. ESQUE. The concept of totipotency and pluripotency. The main characteristics of ESC: proliferation, self-renewal, absence of G1 phase of mitosis. Escrow behaviour in culture. Clone of ESC. Experiments on transplantation of human ESCs into animals. Methods of obtaining ESCOs. Features of the ESC phenotype. ESC to study the genomics of early embryogenesis and organogenesis. Directional differentiation of ESCs in vitro. Obtaining human tissues from totipotent ESCs. ESC: acquisition, differentiation, clinical trials. Transplantation of stem and progenitor cells in medicine.

**Topic 3. Cell culture. (4 hours).**

Relevance of the use of cell cultures in various fields of biology and medicine. The possibility of their use in solving the problems of differentiation and proliferation of cells. The role of cell cultures: (1) in biotechnology in the production of biologically active substances, for the preservation of the gene pool of endangered species (2) in medicine for the diagnosis and treatment of hereditary diseases, as a test system in the development of new drugs.

**Section 2. Prospects for the development and practical application of biomedical cell technologies. (8 hours)**

**Topic 1. Molecular-biological and physico-chemical methods of analysis of cell cultures. (2 hours).**

Methods of analysis of cell cultures: light-optical, immunocytochemical, identification of markers of cell specification, analysis of proliferative activity. Basics of genetic cell typing. Biochip technology to elucidate the spectrum of transcribed genes in cultured cells. Physical methods of cell in vitro examination.

**Topic 2. Technology of paramagnetized cells (2 hours).**

Labeled stem cells. Nanobiomagnetism to determine the migration pathways and fate of transplanted stem cells. Dendrimers as a contrasting agent for magnetic resonance imaging. Iron oxide nanoparticles for magnetic marking of transplanted cells. Supraparamagnetic surfacely carbonized iron oxide nanospheres as a contrast agent for MRI studies. Migration potential and survival of paramagnetically labeled transfected cells in the conditions of their transplantation. Magnetophoresis of paramagnetically labeled cells.

**Topic 3. Biodegradable and biocompatible materials for tissue engineering structures (2 hours).**

Biodegradable and biocompatible nanomaterials. Development of new biodegradable nanomaterials, potential carriers of bioactive molecules, cytoprotectors and regeneration stimulants. Prospects for cell transplantation in carriers based on biodegradable materials. Criteria for biodegradable materials: biocompatibility, optimal biodegradation, elasticity, strength, porosity, ensuring dosed (regulated) release of substances (trophic factors, pharmaceuticals, etc.), bioactivity.

**Topic 4. Biological functional nanosystems. (2 hours).**

Self-assembling nanosystems for reconstruction of the matrix of biological tissue. Stem cell (SC) nanotechnology: nanosystems to create an adequate matrix for stem cells, transfection, isolation and sorting of stem cells, detection of molecules in the STEM, imaging,

tracking of migration paths and fate of IC in vivo, solving tissue engineering problems.

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

Laboratory work 18 hours.

Topic 1. Preparation of dishes, workplace, tools and mortars for the implementation of the project (4 hours).

Topic 2. Preparation of nutrient media and biomaterials (4 hours).

Topic 3: Defrosting of cell cultures (4 hours).

Topic 4. Cultivation of animal cells. Reseeding of cell culture, cell count (6 hours).

Recommended topics of the reports:

1. Advances in the production of recombinant antibodies
2. New biomaterial for transdermal applications: in vitro and in vivo characteristic.



3. Stem cell therapy for the reconstruction of alveolar clefts and traumatic defects in adults.
4. Effect of aspirin and clopidogrel on neural stem cells.
5. Creation of tumor antigen-specific andPSC-derivatives of thymic emigrants using a 3D thymus culture system.
6. Nanofiber framework made of polylactic acid/collagen with improved three-dimensional structure and biomechanical properties.
7. Cancer stem cells and microglia in the processes of invasive growth of glioblastoma multiforme.
8. Technologies of three-dimensional encapsulation of mesenchymal stem cells for biomimetic microenvironment in tissue regeneration.
9. Artificial heart muscle with or without scaffolds.
10. Neural stem cell transplantation and CNS diseases.
11. Advances in drug delivery systems, 0 to 3D add-ons.
12. Analysis of the cell cycle using flow cytometry.
13. High-throughput screening of drug combinations.
14. Modeling of diseases in three-dimensional organoid systems derived from stem cells.

## **V. EDUCATIONAL AND METHODOLOGICAL SUPPORT OF INDEPENDENT WORK OF STUDENTS**

### Recommendations for independent work of students

The purpose of the independent work of the student is to work meaningfully and independently first with educational material, then with scientific information, to lay the foundations of self-organization and self-education in order to instill the ability to further continuously improve their professional qualifications.

The process of organizing the independent work of the student includes the following stages:

- 1) preparatory (setting goals, drawing up a program, preparing methodological support, preparing equipment);
- 2) the main (implementation of the program, the use of methods of information retrieval, assimilation, processing, application, transfer of knowledge, fixation of results, self-organization of the work process);
- 3) final (assessment of the significance and analysis of the results, their systematization, evaluation of the effectiveness of the program and methods of work, conclusions on the directions of labor optimization).

In the process of independent work, the student acquires the skills of self-organization, self-control, self-government, self-reflection and becomes an active independent subject of educational activity. Independent work of students should have an important impact on the formation of the personality of the future

specialist, it is planned by the student independently. Each student independently determines the mode of his work and the measure of work spent on mastering the educational content in each discipline. He performs extracurricular work according to a personal individual plan, depending on his preparation, time and other conditions.

#### Methodical recommendations for independent work of students

As the material on the subject of the discipline is mastered, it is planned to perform independent work of students on the collection and processing of literary material to expand the field of knowledge in the discipline under study, which allows you to deepen and consolidate specific practical knowledge gained in classroom classes. To study and fully master the program material on the discipline, educational, reference and other literature recommended by this program, as well as specialized periodicals, are used.

When independently preparing for classes, students take notes on the material, independently study the issues on the topics covered, using the educational literature from the proposed list, periodicals, scientific and methodological information, databases of information networks.

Independent work consists of such types of work as the study of material on textbooks, reference books, videos and presentations, as well as other reliable sources of information; preparation for the zechet. To consolidate the material, it is enough, flipping through the notes or reading it, mentally restore the material. If necessary, refer to the recommended educational and reference literature, write down incomprehensible moments in the questions to understand them in the upcoming lesson.

Preparation for practical exercises. This type of independent work consists of several stages:

1) Repetition of the studied material. For this purpose, lecture notes, recommended basic and additional literature are used;

2) Deepening knowledge on the proposed topics. It is necessary to differentiate the available material in lectures, textbooks in accordance with the points of the plan of the practical lesson. Separately write out unclear questions, terms. It is better to do this in the margins of the lecture notes or textbook. Clarification should be carried out with the help of reference literature (dictionaries, encyclopedic publications, etc.);

3) Drawing up a detailed plan for the speech, or conducting calculations, solving problems, exercises, etc. In preparation for practical exercises, students take notes on the material, prepare answers to the above questions on the topics of practical exercises. In addition to the practical material, students independently

study questions on the proposed topics, using educational literature from the proposed list, periodicals, scientific and methodological information, databases of information networks (Internet, etc.).

Requirements for the presentation and design of the results of independent work

There are no special requirements for the provision and design of the results of this independent work.

Control over the implementation of the plan of independent work of students is carried out by the teacher in practical classes by interviewing and by including in the final tasks specified in the lesson from the plan of independent work.

## VI. MONITORING THE ACHIEVEMENT OF COURSE OBJECTIVES

| No p/n | Supervised sections / topics of the discipline                                       | Achievement indicator code and name   | Learning outcomes  | Assessment tools       |                                     |
|--------|--|---|--|------------------------|-------------------------------------|
|        |  |   |  | current control        | Intermediate-accurate certification |
| 1.     | The purpose, objectives and theoretical foundations of biomedical cell technologies. | PC-1.1 Works with scientific and technical information and special literature, studies the achievements of domestic and foreign science in the field of molecular and cell biology using new technologies and electronic databases. | He knows the achievements of domestic and foreign science in the field of molecular and cell biology and technologies.<br>Able to work with scientific and technical information and special literature using new technologies and electronic databases<br>Possesses the skills of search and systematization of scientific and technical information, including the use of new technologies and electronic databases. | Oral interview, report | Exam                                |
|        |  | PC-1.2Conceives and formulates diagnostic solutions to the problems of molecular and  | Knows current problems and challenges in the field of biomedical cell technologies<br>Able to  | Oral interview, report | Exam                                |

|  |  |  |  |                        |      |
|--|--|--|--|------------------------|------|
|  |  | cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity  | comprehend and formulate diagnostic solutions to the problems of molecular and cell biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity<br>Has the skills to integrate fundamental biological concepts and specialized knowledge to solve problems in the field of biomedical cell technologies |                        |      |
|  |  | PK-2.3 Applies the methodological foundations of design, laboratory biological, environmental research, uses modern equipment and computing complexes in molecular and cellular biology. | Knows the methodological foundations of design, laboratory biological, environmental research<br>Able to use modern equipment and computing complexes in molecular and cell biology<br>Possesses the skills of design, performing laboratory biological, environmental research using modern equipment and computer systems  | Oral interview, report | Exam |
|  |  | PC-3.2 Detailedly characterizes the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination,                                  | Knows the basic processes occurring in a living cell<br>Able to characterize in detail the main processes occurring in a living cell   | Oral interview, report | Exam |

|    |  |   |   |                        |      |
|----|--|---|---|------------------------|------|
|    |  | repair, processing of RNA and proteins, protein folding and docking.  | Has the skills to control the processes occurring in the cells  |                        |      |
| 2. | Prospects for the development and practical application of biomedical cell technologies. | PC-1.3 Uses in scientific and production-technological activities knowledge of fundamental and applied sections of disciplines that determine the scope of molecular and cellular biology | Knows the fundamental and applied sections of disciplines that determine the scope of activity of biomedical cell technologies<br>Able to use in scientific and production-technological activities knowledge of fundamental and applied sections of molecular and cell biology<br>Has skills use of biomedical cell technologies in scientific and production-technological activities | Oral interview, report | Exam |
|    |  | PC-2.1 Develops rules and algorithms for the design, implementation of laboratory biological and environmental research.  | Knows the rules and algorithms of designing, performing laboratory biological, environmental studies<br>Able to develop rules and algorithms for designing, performing laboratory research.<br>Has the skills to design, perform laboratory biological, environmental research  | Oral interview, report | Exam |

|  |  |   |  |                               |             |
|--|--|---|--|-------------------------------|-------------|
|  |  | <p>PC-2.2 Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.</p>   | <p>Knows the scientific methodological foundations of fundamental research<br/> Able to perform laboratory biological, environmental research using the scientific methodological foundations of fundamental research<br/> Has the skills and experience to perform laboratory tests</p>   | <p>Oral questioning</p>       | <p>Exam</p> |
|  |  | <p>PC-3.1 Studies the structure and functions of biopolymers, their components and complexes, mechanisms of storage, transmission and implementation of genetic information at the molecular level.</p> | <p>Knows the structure and functions of biopolymers, their components and complexes, mechanisms for storing, transmitting and implementing genetic information at the molecular level<br/> Able to investigate the structure and functions of biopolymers, their components and complexes, mechanisms for storing, transmitting and implementing genetic information at the molecular level<br/> Possesses skills and methods for studying the structure and function of biopolymers, their components and complexes, mechanisms for storing, transmitting and</p> | <p>Oral interview, report</p> | <p>Exam</p> |

|  |  |   |   |                        |      |
|--|--|---|---|------------------------|------|
|  |  |   | implementing genetic information at the molecular level   |                        |      |
|  |  | PC-3.3 The study of the main methods of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism. | Knows the main methods of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism<br>Able to investigate the regulation of the processes of functioning of a living cell<br>Possesses the skills of studying intermolecular interactions and mutual regulation of the processes of functioning of a living cell in the composition of a multicellular organism | Oral interview, report | Exam |
|  |  | PC-3.4 Analyzes the structure and functions of genes and genomes, conducts structural and functional analysis of individual proteins and the proteome as a whole.               | Knows the structure and function of genes and genomes, individual proteins and the proteome as a whole<br>Able to analyze the structure of the function of genes and genomes, proteins and proteomes<br>Proficient in the methods of analyzing the structure of the function of genes and genomes, proteins and the proteome as a whole   | Oral interview, report | Exam |

## VII. LIST OF REFERENCES AND INFORMATION AND METHODOLOGICAL SUPPORT OF THE DISCIPLINE

### Main literature

1. Histology, cytology and embryology : textbook / T.M. Studenikina, T.A. Vylegzhanina, T.I. Ostrovskaya, I.A. Stelmakh ; ed. by T.M. Studenikina. — Moscow : INFRA-M, 2023. — 574 p. — (Higher education: Bachelor's degree). - ISBN 978-5-16-006767-4. - Text : electronic. - URL: <https://znanium.com/catalog/product/1916106>
2. Lenchenko, E. M. Cytology, histology and embryology : a textbook for secondary vocational education / E. M. Lenchenko. — 2nd ed., ispr. and add. — Moscow : Izdatelstvo Yurayt, 2023. — 347 p. — (Vocational education). — ISBN 978-5-534-08617-1. — Text : electronic // Educational platform Yurait [site]. — URL: <https://urait.ru/bcode/514046>
3. Polyakova, T. I. Biologiya celli : uchebnoe posobie / T. I. Polyakova, I. B. Sukhov. — St. Petersburg : Sankt-Peterburgskii medico-sotsial'nyi institut, 2015. — 56 p. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: <https://www.iprbookshop.ru/74246.html>
4. Ivanishchev, V. V. Molecular biology : textbook / V.V. Ivanishchev. — Moscow : RIOR : INFRA-M, 2019. — (Higher education). — 225 p. — DOI: <https://doi.org/10.12737/1731-9>. - ISBN 978-5-369-01731-9. - Text : electronic. - URL: <https://znanium.com/catalog/product/1019421>
5. Temnov, M. S. Introduction to Molecular Biology. In 2 parts. Ch.1 : uchebnoe posobie / M. S. Temnov, D. S. Dvoretzky. — Tambov : Tambov State Technical University, EBS ASV, 2021. — 81 c. — ISBN 978-5-8265-2390-2. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: <https://www.iprbookshop.ru/123024.html>
6. Konichev, A. S. Molecular biology : textbook for universities / A. S. Konichev, G. A. Sevastyanova, I. L. Tsvetkov. — 5th ed. — Moscow : Izdatelstvo Yurait, 2023. — 422 p. — (Higher education). — ISBN 978-5-534-13468-1. — Text : electronic // Educational platform Yurait [site]. — URL: <https://urait.ru/bcode/517095>
7. Ershov, Y. A. Biochemistry : textbook and practicum for secondary vocational education / Y. A. Ershov, N. I. Zaitseva ; edited by S. I. Shchukin. — 2nd ed., ispr. and add. — Moscow : Izdatelstvo Yurayt, 2023. — 323 p. — (Vocational education). — ISBN 978-5-534-10400-4. — Text : electronic // Educational platform Yurait [site]. — URL: <https://urait.ru/bcode/517755>



### Further reading

1. New biomedical technologies using dietary supplements. Vol. 2 / Far Eastern Scientific Center of Physiology and Pathology of Respiration of the Siberian Branch of the Russian Academy of Medical Sciences, Research Institute of Medical Climatology and Rehabilitation Treatment; [ed. by E.M. Ivanov]. – Vladivostok 1999. – 127 p.  
<http://lib.dvfu.ru:8080/lib/item?id=chamo:710781&theme=FEFU>
2. Antitumor potential of hematopoietic stem cells on the model of experimental glioblastoma: abstract of the dissertation for the degree of Candidate of Biological Sciences: 03.03.04 / P.V. Mishchenko. – Vladivostok, 2015. – 23 p.  
<http://lib.dvfu.ru:8080/lib/item?id=chamo:799674&theme=FEFU>
3. Tarantul, V.Z. Genno-cell biotechnology of the XXI century and man / V.Z. Tarantul // Russia and the modern world. – № 1 – 2009. – S. 188-203.  
<http://lib.dvfu.ru:8080/lib/item?id=chamo:641555&theme=FEFU>
4. Romanovsky, G.B. Biomedical law in Russia and abroad / G.B. Romanovsky, N.N. Tarusina, A.A. Mokhov [et al.]. – Moscow: Prospekt, 2016. – 364 p. <http://lib.dvfu.ru:8080/lib/item?id=chamo:813279&theme=FEFU>
5. Biology of stem cells and cell technologies: for medical universities in 2 vols.: v. 1 / M.A. Paltsev, R.S. Akchurin, M.A. Alexandrova [et al.]; ed. by M. A. Paltsev. – Moscow: Medicine, Shiko, 2009. – 272 p.  
<http://lib.dvfu.ru:8080/lib/item?id=chamo:779352&theme=FEFU>
6. Biology of stem cells and cell technologies: for medical universities in 2 vols.: v. 2 / M.A. Paltsev, R.S. Akchurin, M.A. Alexandrova [et al.]; ed. by M. A. Paltsev. – Moscow: Medicine, Shiko, 2009. – 455 p.  
<http://lib.dvfu.ru:8080/lib/item?id=chamo:779355&theme=FEFU>

### List of resources of the information and telecommunication network

#### "Internet"

1. <http://elibrary.ru/> - scientific electronic library
2. <http://molbiol.ru/> is an information resource on molecular biology
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 information and cognitive resource dedicated to the natural sciences.
6. <http://www.iprbookshop.ru/> is an electronic library system IPRbooks.
7. <http://znanium.com/> - EBS "Znanium".

8. <https://nplus1.ru/> - N+1, a popular science online publication on science, engineering and technology
9. <http://antropogenez.ru/> - 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; bibliothecar program.
14. <http://www.ebi.ac.uk> website of the European Bioinformatics Institute
15. <http://www.scopus.com> – Bibliographic database and Scopus citation index
16. <http://thomsonreuters.com/thomson-reuters-web-of-science/> bibliographic database and Web of Science citation index

#### List of information technologies and software

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

### VIII.METHODICAL INSTRUCTIONS FOR MASTERING THE DISCIPLINE

**The lecture** is the main active form of conducting classroom classes, explaining 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. The

lecture should always be cognitive, developmental, educational and organizing in nature. Lecture notes help to assimilate the theoretical material of the discipline. When listening to the lecture, it is necessary to take notes – main information, preferably in your own wording, which allows you to better remember the material. The abstract is useful when it is written by the student independently.

In a lecture, the teacher gives only a small fraction of the material on certain topics that are presented in the textbooks. In addition, the teacher 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 such a serious work of the student with the lecture material that allows him to achieve success in mastering new knowledge.

To present a lecture course in the discipline "Biomedical Cell Technologies", the following are used as forms of active learning: lecture-conversation, lecture-visualization, which are based on the knowledge gained by students in the framework of subjects preceding the course. To illustrate verbal information, electronic presentations, tables, video files, diagrams on the board are used. In the course of the presentation of the lecture material, problematic questions or questions with elements of discussion are raised.

#### **Lecture – visualization**

The lecture is accompanied by the display of tables, electronic presentations, video files - such a combination of methods of presenting information greatly simplifies its development by students. Verbal presentation of the material should be accompanied and combined with the visual form. Information presented in the form of diagrams on the board, tables, slides, allows you to form problematic issues, 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 you to involve students in the educational process, as there is a direct contact of the teacher with the audience. Such contact is achieved during the lecture, when students are asked questions of a problematic or informational nature or when they are invited to ask the teacher questions themselves. Questions are offered to the entire audience, and any of the students can offer their answer; another can complement it. During 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, learn how to form questions. The advantage of the lecture-conversation is that it

allows you to attract the attention of students to the most important issues of the topic, determine the content and pace of presentation of the educational material, as well as determine the topics of interest to students, with the aim of possibly adjusting the form of the material taught.

### **Labs**

They are used for conducting experiments, observations of phenomena, processes mainly in the conditions of special laboratories, offices and with the use of technical means. This method stimulates the activity of actions both at the stage of preparation for research and in the process of its implementation. Laboratory work improves the quality of learning, contributes to the development of cognitive activity in students, their logical thinking and creative independence. In the process of performing laboratory work, theoretical knowledge is deepened and concretized, the ability to apply them 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 us to better understand the mechanisms of 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 sessions aimed at experimental confirmation of theoretical positions. In the process of laboratory activity, students perform one or more laboratory works (tasks) under the guidance of a teacher in accordance with the studied content of the educational material. The performance of laboratory work by students is 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 conducted by the teacher;
- independent activity of students;
- discussion of the results of the laboratory work (task).

Before performing a laboratory task (work), students' knowledge is tested - their theoretical readiness to perform the task.

**Laboratory task (work) can be reproductive, partially search and search in nature.**

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

The works, which are **of a partial-exploratory** nature, differ in that when conducting 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, instructional and reference literature.

Works of a **exploratory** nature are distinguished by the fact that students must solve a new problem for them, relying on their theoretical knowledge.

The forms of organization of students for conducting a laboratory lesson - frontal, group and individual - is determined by the teacher, based on the topic, purpose, order of work. With the frontal form of organization of classes, all students perform the same work. In the group form of organizing classes, the same work is performed in teams of 2-5 people. With an individual form of organization of 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, grades for the implementation 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 are one of the types of practical classes designed for in-depth study of the discipline, conducted in an interactive mode. At the classes on the topic of the colloquium, questions are analyzed, and then, together with the teacher, their discussion is held, which is aimed at consolidating the material, forming the skills to conduct polemics, 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 colloquia, the following are used: a detailed conversation, a debate, a press conference.

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

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

**Press conference.** The teacher instructs several students to prepare brief (thesis) messages. After the reports, students ask questions that 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-situation analysis based on learning by solving specific problems - situations (solving cases). The method of specific situations (case study method) refers to non-game imitative active learning 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 number 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 should analyze the situation, understand the essence of the problems, offer possible solutions and choose the best of them. Thanks to the knowledge gained at the lecture, it is easy for the student to correlate the theoretical baggage of knowledge obtained with the real practical situation. Being an interactive method of teaching, it wins a positive attitude from students, who see in it an opportunity to show initiative, feel independent in mastering theoretical positions 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 teacher.

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

- identification, selection and problem solving;
- work with information – comprehension of the meaning of the details described in the situation;
- analysis and synthesis of information and arguments;
- work with assumptions and conclusions;
- evaluation of alternatives;
- decision-making;
- listening and understanding other people are group work skills. 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 alone with real situations.

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

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

Brainstorming (brainstorming) is a widely used way of producing new ideas to solve scientific and practical problems. Its purpose is to organize collective mental activity to find non-traditional ways to solve problems.

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

- creative assimilation of educational material by students;
- the relationship of theoretical knowledge with practice;
- activation of educational and cognitive activity of trainees;
- formation of the ability to concentrate attention and mental efforts on solving an urgent problem;
- formation of experience of collective mental activity.

The problem formulated in the brainstorming session should have theoretical or practical relevance and arouse the active interest of students. A common requirement to consider when choosing a problem for brainstorming is the possibility of many ambiguous options for solving a problem that is put forward to students as a learning task.

### **Tests and testing**

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

From the assessments of laboratory, colloquiums, tests and testing, an assessment of this discipline is mainly formed.

## **IX. MATERIAL AND TECHNICAL SUPPORT OF DISCIPLINE**

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

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

### **Logistics and Software Discipline**

| Name of special premises and premises for independent work                  | Equipment special premises and rooms for independent work             | List of licensed software. Details of the supporting document |
|---|---|---|
| 690922, Primorsky Krai, Vladivostok, Russky Island, Saperny Peninsula, Ajax | Multimedia audience: 236*147 cm Trim Screen Line; DLP Projector, 3000 | -   |

|  |   |          |
|--|---|----------|
| <p>village, 10, aud. M 605</p>   | <p>ANSI Lm, WXGA<br/>1280x800, 2000:1 EW330U<br/>Mitsubishi; Specialized<br/>Equipment Mount<br/>Subsystem CORSA-2007<br/>Tuarex; Video Switching<br/>Subsystem: DVI DXP 44<br/>DVI Protron Matrix Switch<br/>DVI 201 Tx/Rx Extron<br/>Twisted Pair Extension<br/>Cable; Audio Switching and<br/>Sound Amplification<br/>Subsystem; SI 3CT LP<br/>Extron Ceiling Mount Speaker;<br/>DMP 44 LC Extron Digital<br/>Audio Processor; Extension<br/>for IPL T CR Control<br/>Controller 48; Wireless<br/>LANs for trainees are<br/>provided with a system based<br/>on 802.11a/b/g/n 2x2<br/>MIMO(2SS) access points.<br/>HP All-in-One 400 All-in-<br/>One 19.5 (1600x900), Core<br/>i3-4150T, 4GB DDR3-1600<br/>(1x4GB), 1TB HDD 7200<br/>SATA, DVD+/-RW, GigEth,<br/>Wi-Fi, WT, usb kbd/mse,<br/>Win7Pro (64-<br/>bit)+Win8.1Pro(64-bit), 1-1-<br/>1 Wty</p> |          |
| <p>690922, Primorsky Krai,<br/>Vladivostok, Russky Island,<br/>Saperny Peninsula, Ajax<br/>village, 10, aud. M 422</p> | <p>Multimedia audience:<br/>Monoblock HP ProOne 400<br/>G1 AiO 19.5" Intel Core i3-<br/>4130T 4GB DDR3-1600<br/>SODIMM (1x4GB)500GB;<br/>Projection screen Projecta<br/>Elpro Electrol, 300x173 cm;<br/>Multimedia projector,<br/>Mitsubishi FD630U, 4000<br/>ANSI Lumen, 1920x1080;<br/>Mortise interface with TLS<br/>TAM 201 Stan automatic<br/>cable retraction system;<br/>Avervision CP355AF<br/>Visualizer; Microphone<br/>cordless radio system UHF<br/>band Sennheiser EW 122 G3<br/>consisting of a wireless<br/>microphone and receiver;<br/>LifeSizeExpress 220-<br/>Codeonly- Non-AES video</p>  | <p>-</p> |



|  |  |  |
|--|--|--|
|  | <p>conferencing codec; Network video camera Multipix MP-HD718; Two 47" LCD panels, Full HD, LG M4716CCBA; Subsystem of audio switching and sound amplification; centralized uninterrupted power supply</p> |  |
|--|--|--|

## X. VALUATION FUNDS

| No p/n | Supervised sections / topics of the discipline                                       | Achievement indicator code and name   | Learning outcomes   | Assessment tools       |                                     |
|--------|--|---|---|------------------------|-------------------------------------|
|        |  |   |   | current control        | Intermediate-accurate certification |
| 3.     | The purpose, objectives and theoretical foundations of biomedical cell technologies. | PC-1.1 Works with scientific and technical information and special literature, studies the achievements of domestic and foreign science in the field of molecular and cell biology using new technologies and electronic databases. | He knows the achievements of domestic and foreign science in the field of molecular and cell biology and technologies. Able to work with scientific and technical information and special literature using new technologies and electronic databases<br>Possesses the skills of search and systematization of scientific and technical information, including the use of new technologies and electronic databases. | Oral interview, report | Exam Questions 1-25                 |
|        |  | PC-1.2 Conceives and formulates diagnostic solutions to the problems of molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of                                     | Knows current problems and challenges in the field of biomedical cell technologies<br>Able to comprehend and formulate diagnostic solutions to the problems of molecular and cell biology by integrating  |                        | Oral interview, report              |

|  |  |  |   |                        |                     |
|--|--|--|---|------------------------|---------------------|
|  |  | professional activity  | fundamental biological concepts and specialized knowledge in the field of professional activity<br>Has the skills to integrate fundamental biological concepts and specialized knowledge to solve problems in the field of biomedical cell technologies   |                        |                     |
|  |  | PK-2.3 Applies the methodological foundations of design, laboratory biological, environmental research, uses modern equipment and computing complexes in molecular and cellular biology.                                     | Knows the methodological foundations of design, laboratory biological, environmental research<br>Able to use modern equipment and computing complexes in molecular and cell biology<br>Possesses the skills of design, performing laboratory biological, environmental research using modern equipment and computer systems | Oral interview, report | Exam Questions 1-25 |
|  |  | PC-3.2 Detailedly characterizes the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, processing of RNA and proteins, protein folding and docking. | Knows the basic processes occurring in a living cell<br>Able to characterize in detail the main processes occurring in a living cell<br>Has the skills to control the processes occurring in the cells  | Oral interview, report | Exam Questions 1-25 |

|    |  |   |   |                        |                     |
|----|--|---|---|------------------------|---------------------|
| 4. | Prospects for the development and practical application of biomedical cell technologies. | PC-1.3 Uses in scientific and production-technological activities knowledge of fundamental and applied sections of disciplines that determine the scope of molecular and cellular biology | Knows the fundamental and applied sections of disciplines that determine the scope of activity of biomedical cell technologies<br>Able to use in scientific and production-technological activities knowledge of fundamental and applied sections of molecular and cell biology<br>Has skills use of biomedical cell technologies in scientific and production-technological activities | Oral interview, report | Exam Questions 1-25 |
|    |  | PC-2.1 Develops rules and algorithms for the design, implementation of laboratory biological and environmental research.  | Knows the rules and algorithms of designing, performing laboratory biological, environmental studies<br>Able to develop rules and algorithms for designing, performing laboratory research.<br>Has the skills to design, perform laboratory biological, environmental research  | Oral interview, report | Exam Questions 1-25 |
|    |  | PC-2.2 Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.  | Knows the scientific methodological foundations of fundamental research<br>Able to perform laboratory biological, environmental   | Oral questioning       | Exam Questions 1-25 |

|  |  |  |   |                        |                     |
|--|--|--|---|------------------------|---------------------|
|  |  |  | research using the scientific methodological foundations of fundamental research<br>Has the skills and experience to perform laboratory tests   |                        |                     |
|  |  | PC-3.1 Studies the structure and functions of biopolymers, their components and complexes, mechanisms of storage, transmission and implementation of genetic information at the molecular level. | Knows the structure and functions of biopolymers, their components and complexes, mechanisms for storing, transmitting and implementing genetic information at the molecular level<br>Able to investigate the structure and functions of biopolymers, their components and complexes, mechanisms for storing, transmitting and implementing genetic information at the molecular level<br>Possesses skills and methods for studying the structure and function of biopolymers, their components and complexes, mechanisms for storing, transmitting and implementing genetic information at the molecular level | Oral interview, report | Exam Questions 1-25 |
|  |  | PC-3.3The study of the main methods of intermolecular interactions and mutual regulation   | Knows the main methods of intermolecular interactions and mutual regulation of the processes of   | Oral interview, report | Exam Questions 1-25 |

|  |  |   |   |                        |                     |
|--|--|---|---|------------------------|---------------------|
|  |  | of the processes of functioning of a living cell as part of a multicellular organism.   | functioning of a living cell as part of a multicellular organism<br>Able to investigate the regulation of the processes of functioning of a living cell<br>Possesses the skills of studying intermolecular interactions and mutual regulation of the processes of functioning of a living cell in the composition of a multicellular organism |                        |                     |
|  |  | PC-3.4 Analyzes the structure and functions of genes and genomes, conducts structural and functional analysis of individual proteins and the proteome as a whole. | Knows the structure and function of genes and genomes, individual proteins and the proteome as a whole<br>Able to analyze the structure of the function of genes and genomes, proteins and proteomes<br>Proficient in the methods of analyzing the structure of the function of genes and genomes, proteins and the proteome as a whole       | Oral interview, report | Exam Questions 1-25 |

### Scale for assessing the level of formation of competency indicators

| Code and wording of competency indicators                          | Stages of formation |  | Criteria   | Indicators   | Points |
|--|---------------------|--|--|--|--------|
| PK-1.1 Works with scientific and technical information and special | Knows               | achievements of domestic and foreign science in the field of molecular and cell biology. | <b>knowledge of only the basic material</b> about the achievements of domestic and foreign | <b>demonstrates knowledge about the</b> achievements of domestic and foreign science in the field of | 61-75  |

|  |       |   |  |   |        |
|--|-------|---|--|---|--------|
| literature, studies the achievements of domestic and foreign science in the field of molecular and cell biology using new technologies and electronic databases  |       |   | science in the field of molecular and cell biology   | molecular and cell biology  |        |
|  | Can   | work with scientific and technical information and specialized literature in the field of molecular and cell biology using new technologies and electronic databases.   | <b>ability to</b> work with scientific and technical information and specialized literature in the field of molecular and cell biology using new technologies and electronic databases in solving practical issues and problems  | <b>demonstrates (knowledge-based) the ability to</b> work with scientific and technical information and specialized literature in the field of molecular and cell biology using new technologies and electronic databases   | 76-85  |
|  | Owns  | skills in working with scientific and technical information and specialized literature, including the use of new technologies and electronic databases.   | <b>deep and solid knowledge and skills</b> in working with scientific and technical information and specialized literature, including the use of new technologies and electronic databases.  | <b>demonstrates skills</b> in working with scientific and technical information and specialized literature, including the use of new technologies and electronic databases.   | 86-100 |
| PC-1.2Conceives and formulates diagnostic solutions to the problems of molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity | Knows | actual problems of molecular and cell biology   | <b>knowledge of only the basic material about</b> topical problems of molecular and cell biology   | <b>demonstrates knowledge</b> of current problems of molecular and cell biology   | 61-75  |
|  | Can   | to comprehend and formulate diagnostic solutions to the problems of molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity | the ability to comprehend and formulate diagnostic solutions to the problems of molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity in solving practical issues and problems | <b>demonstrates (on the basis of knowledge) the ability</b> to comprehend and formulate diagnostic solutions to the problems of molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity | 76-85  |
|  | Owns  | skills in understanding and formulating diagnostic solutions to problems of molecular and cell biology by integrating fundamental biological concepts   | <b>deep and solid mastery</b> of the skills of comprehension and formulation of diagnostic solutions to the problems of molecular and  | <b>demonstrates the skills</b> of comprehension and formulation of diagnostic solutions to the problems of molecular and cell   | 86-100 |

|   |       |   |  |  |        |
|---|-------|---|--|--|--------|
|   |       | and specialized knowledge in the field of professional activity   | cellular biology through the integration of fundamental biological concepts and specialized knowledge in the field of professional activity  | biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity   |        |
| PC-1.3 Uses in scientific and production-technological activities knowledge of fundamental and applied sections of disciplines that determine the scope of molecular and cellular biology | Knows | fundamental and applied sections of disciplines that determine the scope of molecular and cellular biology                                      | <b>knowledge of only the basic material about the</b> fundamental and applied sections of the disciplines that determine the scope of molecular and cell biology   | <b>demonstrates knowledge</b> of the fundamental and applied sections of the disciplines that determine the scope of molecular and cellular biology  | 61-75  |
|   | Can   | to use in scientific and production-technological activities knowledge of fundamental and applied sections of molecular and cellular biology    | <b>the ability to</b> use knowledge of fundamental and applied sections of molecular and cell biology in solving practical issues and problems in scientific and production-technological activities         | <b>demonstrates (on the basis of knowledge) the ability to</b> use in scientific and production-technological activities knowledge of fundamental and applied sections of molecular and cell biology | 76-85  |
|   | Owns  | skills of use in scientific and production-technological activities knowledge of fundamental and applied sections of molecular and cell biology | <b>deep and solid possession of knowledge, skills and abilities</b> of use in scientific and production-technological activities knowledge of fundamental and applied sections of molecular and cell biology | <b>demonstrates the skills</b> of using knowledge of fundamental and applied sections of molecular and cell biology in scientific and production-technological activities                            | 86-100 |
| PC-2.1 Develops rules and algorithms for the design, implementation of laboratory biological and environment  | Knows | rules and algorithms for designing, performing laboratory biological, environmental studies   | <b>knowledge of only the basic material</b> about the rules and algorithms of design, performance of laboratory biological, environmental studies  | <b>demonstrates knowledge</b> of the rules and algorithms of design, performance of laboratory biological, environmental studies   | 61-75  |
|   | Can   | develop rules and   | <b>the ability to use</b>  | <b>demonstrates (on</b>  | 76-    |

|   |       |   |  |  |        |
|---|-------|---|--|--|--------|
| al research.  |       | algorithms for designing, performing laboratory biological and environmental research.  | <b>knowledge of the basic material in solving practical issues</b> and problems and develop rules and algorithms for designing, performing laboratory biological and environmental research. | <b>the basis of knowledge) the solution of practical issues</b> and problems of developing rules and algorithms for designing, performing laboratory biological and environmental studies.   | 85     |
|   | Owns  | skills in designing, performing laboratory biological, environmental research   | <b>deep and solid knowledge, skills and abilities of</b> designing, performing laboratory biological, environmental research   | <b>demonstrates the skills</b> of design, performing laboratory biological, environmental research   | 86-100 |
| PC-2.2<br>Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research. | Knows | scientific methodological foundations of fundamental research   | <b>knowledge of only the basic material</b> on the scientific methodological foundations of fundamental research   | <b>demonstrates knowledge of the</b> scientific methodological foundations of fundamental research   | 61-75  |
|   | Can   | perform laboratory biological, environmental research using the scientific methodological foundations of fundamental research | <b>the ability</b> to perform laboratory biological and environmental research using the scientific methodological foundations of fundamental research in solving practical issues and tasks | <b>demonstrates (on the basis of knowledge) the ability</b> to perform laboratory biological, environmental research using the scientific methodological foundations of fundamental research | 76-85  |
|   | Owns  | skills and experience in performing laboratory biological and environmental research  | <b>a deep and solid knowledge of knowledge, skills and experience</b> in performing laboratory biological and environmental research   | <b>demonstrates the skills</b> of performing laboratory biological and environmental studies   | 86-100 |
| PK-2.3<br>Applies the methodological  | Knows | methodological foundations of design, performance of laboratory   | <b>knowledge of only the basic material</b> on the application of the  | <b>demonstrates knowledge of the</b> application of methodological   | 61-75  |



|   |       |   |  |   |        |
|---|-------|---|--|---|--------|
| foundations of design, laboratory biological, environmental research, uses modern equipment and computing complexes in molecular and cellular biology.  |       | biological, environmental studies   | methodological foundations of design, the implementation of laboratory biological, environmental research  | foundations of design, performance of laboratory biological, environmental studies  |        |
|   | Can   | use modern equipment and computing complexes in molecular and cell biology  | <b>the ability to</b> use modern equipment and computing complexes in molecular and cell biology in solving practical questions and problems   | <b>demonstrates (on the basis of knowledge) the ability</b> to use modern equipment and computing complexes in molecular and cellular biology in solving practical questions and problems                         | 76-85  |
|   | Owns  | skills in designing, performing laboratory biological, environmental research using modern equipment and computer systems   | <b>deep and solid knowledge, skills and abilities of</b> designing, performing laboratory biological, environmental research using modern equipment and computer systems   | <b>demonstrates the skills</b> of design, performing laboratory biological, environmental research using modern equipment and computer systems  | 86-100 |
| PC-3.1<br>Studies the structure and functions of biopolymers, their components and complexes, mechanisms of storage, transmission and implementation of genetic information at the molecular level. | Knows | structure and functions of biopolymers, their components and complexes, mechanisms of storage, transmission and implementation of genetic information at the molecular level                | <b>knowledge of only the basic material</b> about the structure and functions of biopolymers, their components and complexes, mechanisms of storage, transmission and implementation of genetic information at the molecular level | <b>demonstrates knowledge of the</b> structure and functions of biopolymers, their components and complexes, mechanisms of storage, transmission and implementation of genetic information at the molecular level | 61-75  |
|   | Can   | to investigate the structure and functions of biopolymers, their components and complexes, mechanisms for storing, transmitting and implementing genetic information at the molecular level | <b>ability</b> to investigate the structure and functions of biopolymers, their components and complexes, mechanisms of storage, transmission and implementation of genetic information at the                                     | <b>demonstrates (on the basis of knowledge) the solution of practical issues and tasks of</b> studying the structure and functions of biopolymers, their components and complexes,                                | 76-85  |

|   |       |  |   |  |        |
|---|-------|--|---|--|--------|
|   |       |  | molecular level   | mechanisms for storing, transmitting and implementing genetic information at the molecular level   |        |
|   | Owns  | skills and methods of studying the structure and function of biopolymers, their components and complexes, mechanisms for storing, transmitting and implementing genetic information at the molecular level | <b>deep and solid possession of knowledge, skills and techniques</b> for studying the structure and function of biopolymers, their components and complexes, mechanisms for storing, transmitting and implementing genetic information at the molecular level | <b>demonstrates the skills</b> and methods of studying the structure and function of biopolymers, their components and complexes, mechanisms for storing, transmitting and implementing genetic information at the molecular level | 86-100 |
| PC-3.2<br>Detailedly characterizes the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, processing of RNA and proteins, protein folding and docking. | Knows | the main processes occurring in a living cell  | <b>knowledge of only the basic material</b> about the basic processes occurring in a living cell  | <b>demonstrates knowledge</b> of the basic processes occurring in a living cell  | 61-75  |
|   | Can   | to characterize in detail the main processes occurring in a living cell  | <b>the ability to</b> characterize in detail the main processes occurring in a living cell in solving practical questions and problems  | <b>demonstrates (on the basis of knowledge) the ability</b> to characterize in detail the main processes occurring in a living cell  | 76-85  |
|   | Owns  | knowledge of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking   | <b>deep and solid knowledge, skills and abilities</b> about the processes of replication, transcription, translation, recombination, repair, processing of RNA and proteins, protein folding and docking  | <b>demonstrates the skills</b> of cognition of the processes of replication, transcription, translation, recombination, repair, processing of RNA and proteins, protein folding and docking  | 86-100 |
| PC-3.3<br>The study of the main methods of intermolecular interactions and mutual regulation of   | Knows | the main methods of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism   | <b>knowledge of only the basic material</b> about the basic methods of intermolecular interactions and mutual regulation of the processes of functioning of a   | <b>demonstrates knowledge</b> of the main methods of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of   | 61-75  |

|  |       |  |   |   |        |
|--|-------|--|---|---|--------|
| the processes of functioning of a living cell as part of a multicellular organism.   |       |  | living cell as part of a multicellular organism   | a multicellular organism  |        |
|  | Can   | to investigate intermolecular interactions and mutual regulation of the processes of functioning of a living cell  | <b>ability to</b> investigate intermolecular interactions and mutual regulation of the processes of functioning of a living cell in solving practical problems and problems   | <b>demonstrates (on the basis of knowledge) the solution of practical issues and tasks</b> of studying intermolecular interactions and mutual regulation of the processes of functioning of a living cell | 76-85  |
|  | Owns  | skills in the study of intermolecular interactions and mutual regulation of the processes of functioning of a living cell in the composition of a multicellular organism | <b>deep and solid possession of knowledge, skills and abilities in</b> the study of intermolecular interactions and mutual regulation of the processes of functioning of a living cell in the composition of a multicellular organism | <b>demonstrates the skills of</b> studying intermolecular interactions and mutual regulation of the processes of functioning of a living cell in the composition of a multicellular organism              | 86-100 |
| PC-3.4<br>Analyzes the structure and functions of genes and genomes, conducts structural and functional analysis of individual proteins and the proteome as a whole. | Knows | the structure and function of genes and genomes, individual proteins and the proteome as a whole   | <b>knowledge of only the basic material</b> about the structure and function of genes and genomes, individual proteins and the proteome as a whole  | <b>demonstrates knowledge of the</b> structure and function of genes and genomes, individual proteins and the proteome as a whole   | 61-75  |
|  | Can   | analyze the structure of the function of genes and genomes, proteins and proteomes   | <b>ability to</b> analyze the structure of the function of genes and genomes, proteins and proteomes in solving practical problems and problems   | <b>demonstrates (on the basis of knowledge) the solution of practical problems and problems</b> of analysis of the structure of the function of genes and genomes, proteins and proteomes                 | 76-85  |

|  |          |  |   |  |        |
|--|----------|--|---|--|--------|
|  | Own<br>s | by methods of analyzing the structure of the function of genes and genomes, proteins and the proteome as a whole | <b>deep and solid knowledge, skills and abilities</b> to analyze the structure of the function of genes and genomes, proteins and the proteome as a whole | <b>demonstrates skills in</b> analyzing the structure of function of genes and genomes, proteins and the proteome in general | 86-100 |
|--|----------|--|---|--|--------|

### **Assessment tools for intermediate attestation**

#### **Oral questioning.**

Oral questioning allows you to assess the knowledge and logic of the student, the ability to use terminology, speech skills and other communication skills.

The training function is to identify details that for some reason were not sufficiently understood during the training sessions and in preparation for the test.

A survey is a means of control, organized as a special conversation of the teacher with the student on topics related to the discipline being studied, and designed to clarify the amount of knowledge of the student on a certain section, topic, problem, etc.

#### **Examples of topics for oral inquiry**

1. The concept of "cell culture".
2. The history of the development of methods of culturing animal and human cells. The researchers who received the first cell cultures, the first vertebrate cell cultures.
3. The first permanent line of human cells.
4. Principles of culturing animal cells in vitro: compliance with aseptic conditions, the use of artificial nutrient media.
5. Laboratory utensils, consumables and nutrient media for cell culture.
6. Serum and growth factors.
7. Serum and serum-free nutrient media.
8. Monolayer and suspension cultures as the main variants of animal cell culture.
9. Factors of cell adhesion. 2-D and 3-D cell culture.
10. Technological approaches that support aseptic conditions.
11. Care of the workplace, requirements for working personnel. Technique of work in laminar boxing.
12. Types of laminar cabinets (boxes), their design features and purpose.

13. Methods of sterilization of culture dishes, tools, materials, depending on the composition of the materials used for their manufacture.
14. Types and properties of basic polymers and plastic products.
15. Sterilization of nutrient media.
16. Modes of autoclaving of solutions and consumables. Sterilizing filtration of thermolabile components of nutrient media.
17. Control of sterility and contamination of animal cell cultures.
18. General requirements for the laboratory for the cultivation of cells and tissues. Physical growing conditions.
19. Growth phases of cell and tissue cultures, their characteristics.
20. Features of growing human and animal cells.
21. Types of cell cultures depending on their origin.
22. Features of cell cultures obtained from embryonic and mature, normal and tumor tissues.
23. Primary cultures and cell lines.
24. Methods of tissue disaggregation: mechanical and enzymatic. Transformation of cells into permanent lines. Signs of permanent cell lines. Benefits of permanent cell lines.
25. The concept of regenerative medicine and the field of application of biomedical cell technologies.
26. The idea and principles of the development of personalized medicine.
27. Stem cell niche.
28. Extracellular matrix, its role.
29. Control of cell reproduction and differentiation.

### **Set of tasks for test work**

The student performs one test work of a certain variant. The choice of option is carried out in accordance with the initial letter of the student's surname:

- |                         |                             |
|-------------------------|-----------------------------|
| A – 1 option            | O – option 8                |
| B – option 2            | P – 9 option                |
| B, D – 3 option         | P – 10 option               |
| D, E, G, 3 – 4 variants | C – option 11               |
| I, K – option 5         | T – option 12               |
| L – option 6            | U, F, X, C, H - 13 option   |
| M, I – option 7         | W, Sch, E, U, Z – option 14 |

The test work consists of 4 theoretical questions.

When performing work, you should use the attached list of basic and additional literature. Answers to questions should be specific and cover the

material available in this section, both in mandatory and in additional literature. It is necessary to answer questions in your own words. Copying and rewriting of text from the textbook is unacceptable. Quotation marks are placed when quoting, at the end of the quotation in parentheses a number indicates a reference to the source used.

During the preparation of the test work, you should use the knowledge gained in the study of other subjects.

It is also necessary to take into account the experience of one's own work.

The pages of the notebook should be numbered, a list of used literature should be given, designed in accordance with the current requirements of the bibliography, the work should be signed, and the date of its implementation should be put.

For the reviewer's comments, it is necessary to leave the fields and at the end of the notebook a sheet for the final review.

On the title page of the test work, you should indicate the surname, name, patronymic of the student (in full), the course, the group number, the name of the discipline and the number of the version of the task performed.

The work should be performed in strict accordance with the sequence of questions set forth in the version of the task.

Tests must be submitted no later than the first day of the intermediate certification.

## **Job**

### **Option 1**

1. Chromosome morphology. Homologous chromosomes, chromatids.
2. Adipose tissue, morpho-functional characteristic.
3. Types of adipose tissue, structure, functions.
4. Basal body, structure, biological role. Intercellular substance of connective tissues. Components, functional value.

### **Option 2**

1. Division of prokaryotes.
2. Non-granular leukocytes: varieties, number, size, structure, function, regeneration.
3. Cytoplasm: chemical composition.
4. General characteristics of dense connective tissue; main types, structure, functions, regeneration.

### **Option 3**

1. Inorganic substances of hyaloplasm: macro- and microelements, biological role.

2. Loose fibrous unformed connective tissue: cellular composition and intercellular substance, morpho-functional characteristic.
3. Cellular inclusions; types and importance for cell metabolism.
4. Granular leukocytes: types, structure, function, life expectancy, regeneration.

**Option 4**

1. Structure and functions of the nuclear envelope; features of the structure of nuclear pores.
2. Connective tissues with special properties; types, structure, functions, regeneration.
3. Structure and functions of the fission spindle; features of the formation of a spindle of division in plant and animal cells.
4. The concept of T- and B-lymphocytes; characteristics of T- and Vlymphocytes.

### **Option 5**

1. Microscopic structure of mitochondria; their biological role in the cell.
2. General characteristics of the glandular epithelium. Structure of secretory cells; types of secretion.
3. Structure and functions of the cell center; diplasome (maternal and daughter centrioles), astrosphere.
4. Granular leukocytes: types, structure, biological role, regeneration.

### **Option 6**

1. Structure and functions of ribosomes; large and small subunits; the amount of protein and rRNA in ribosomes.
2. Multilayered epithelium; varieties, structure, biological role, regeneration.
3. Organic substances of hyaloplasm: types, functions.
4. Features of the structure of cells of cardiac muscle tissue - cardiomyocytes. Properties and histogenesis of cardiomyocytes.

### **Option 7**

1. The structure and biological role of the basal body.
2. Neuroglial cells (macroglia and microglia): classification, structure, biological role, regeneration.
3. Microtubules: chemical composition, structure, biological role.
4. Cambial and stationary tissues of the body; tissue regeneration.

### **Option 8**

1. Cilia and flagella of eukaryotes: structure and biological role.
2. General characteristics of nervous tissue.
3. Vacuoles of plant and animal cells: types, structure, functions.
4. General characteristics of muscle tissue; species, regeneration, histogenesis.

### **Option 9**

1. Structure and functions of chromatin; euchromatin and heterochromatin (facultative and constitutive).
2. Glandular epithelium: structure, biological role, regeneration. Morpho-functional characteristics of the glands of the body.
3. Life cycle of the cell; interphase (presynthetic, synthetic and postsynthetic periods), cell division.
4. The main types of tooth tissues.

### **Option 10**

1. Amitosis - direct cell division; varieties of amitosis, its biological role.
2. General characteristics of the integumentary and lining epithelium.



3. Theories of the origin of mitochondria; the importance of mitochondria in the life of the cell.

4. Platelets: structure, biological role, life expectancy, regeneration.

**Evaluation criteria (written response)**

✓ 100-86 points - if the answer shows a deep and systematic knowledge of all the program material and the structure of a particular question, as well as the main content and innovations of the lecture course in comparison with the educational literature. The student demonstrates a clear and fluent knowledge of the conceptual and conceptual apparatus, scientific language and terminology of the relevant scientific field. Knowledge of the main literature and familiarity with additionally recommended literature. Logically correct and a convincing response.

✓ 85-76 points - knowledge of the key problems of the program and the main content of the lecture course; the ability to use the conceptual and conceptual apparatus in the process of analyzing the main problems within the framework of this topic; knowledge of the most important works from the list of recommended literature. In general, a logically correct, but not always accurate and reasoned presentation of the answer.

✓ 75-61 points - fragmentary, superficial knowledge of the most important sections of the program and the content of the lecture course; difficulties with the use of the scientific and conceptual apparatus and terminology of the academic discipline; incomplete acquaintance with the recommended literature; partial difficulties with the implementation of the tasks provided for in the program; the desire to state the answer logically and consistently.

✓ 60-50 points - ignorance, or a fragmentary representation of this problem within the framework of educational and program material; inability to use the conceptual apparatus; lack of logical connection in the answer.

**List of discussion topics for the round table  
(discussions, polemics, debates, debates)**

1. Topic Title 1
2. Topic Title 1

**Evaluation criteria:**

✓ 100-86 points are given to a student if the student expressed his opinion on the formulated problem, argued it, accurately determining its content and components. The data of domestic and foreign literature, statistical information, information of a regulatory and legal nature are given. The student knows and

possesses the skill of independent research work on the research topic; methods and techniques of analysis of theoretical and / or practical aspects of the studied area. There are no actual errors related to understanding the problem; graphically the work is designed correctly

✓ 85-76 points - the work is characterized by semantic integrity, coherence and consistency of presentation; no more than 1 error was made when explaining the meaning or content of the problem. For reasoning, the data of domestic and foreign authors are given. Research skills and abilities are demonstrated. There are no actual errors related to understanding the problem. One or two mistakes were made in the design of the work

✓ 75-61 points - the student conducts a fairly independent analysis of the main stages and semantic components of the problem; understands the basic basics and theoretical justification of the chosen topic. The main sources on the topic under consideration are involved. No more than 2 mistakes were made in the meaning or content of the problem, the design of the work

✓ 60-50 points - if the work is a retold or completely rewritten source text without any comments, analysis. The structure and theoretical component of the topic are not disclosed. Three or more errors were made in the semantic content of the problem being revealed, in the design of the work.

### **Criteria for evaluating the creative task performed in the practical lesson**

✓ 100-86 points are given if the student / group expressed their opinion on the formulated problem, argued it, accurately determining its content and components. The data of domestic and foreign literature, statistical information, information of a regulatory and legal nature are given. Knowledge and possession of the skill of independent research work on the research topic is demonstrated; methods and techniques of analysis of international political practice. There are no actual errors related to understanding the problem

✓ 85-76 points - the work of the student / group is characterized by semantic integrity, coherence and consistency of presentation; no more than 1 error was made when explaining the meaning or content of the problem. For reasoning, the data of domestic and foreign authors are given. Research skills and abilities are demonstrated. There are no actual errors related to understanding the problem.

✓ 75-61 points - a fairly independent analysis of the main stages and semantic components of the problem was carried out; understanding of the basic foundations and theoretical justification of the chosen topic. The main sources on the topic under consideration are involved. No more than 2 mistakes were made in the meaning or content of the problem

✓ 60-50 points - if the work is a retold or completely rewritten source text without any comments, analysis. The structure and theoretical component of the topic are not disclosed. Three or more errors were made in the semantic content of the problem being disclosed.

### **Essay topics (abstracts, reports, communications)**

1. Modern ideas about the structure and functional significance of intercellular compounds In particular: Classification and ultrastructural structure of intercellular compounds. Functional significance of cellular compounds of various types. The structure of contacts and their role in intercellular interaction. The unification and interaction of cells with each other.

2. Tissues as a system of cells and their derivatives - one of the hierarchical levels of organization of the living.

3. Modern ideas about cell apoptosis. Causes and mechanisms of apoptosis.

4. Cooperation of cellular structures in metabolic processes In particular: Structures that provide synthesis, transport, accumulation and release of proteins. The processes of proteolysis in cells and the structures that provide them. The role of lysosomes in various cells in conditions of norm and pathology.

5. Mechanisms of cell differentiation.

6. Integration and interaction of cells.

7. Modern ideas about the membrane system of the cell. In particular: Cell membranes. Membrane conveyor. Barrier-receptor and transport systems of the cell. Molecular and ultrastructural bases of cell reception. Membrane receptor proteins

8. Modern ideas about the transport systems of cells. In particular: Types and mechanisms of protein-mediated transmembrane cell transport. Processes of transfer of substances through the plasmolemma. Violations of transport systems in diseases.

9. The influence of alcoholism, infectious diseases and drugs on human embryogenesis. Placenta. The functional system of the mother is the fetus. Amnion, education, biological significance, functions. The role of pharmacist organs in the development and protection of the embryo.

10. History of embryology as a science.

11. Morphofunctional mother-fetus system.

12. Variants of development of mono- and dizygotic twins.

13. Anomalies of human embryonic development.

14. Critical periods of human development.

15. Formation of the axial complex of organ rudiments, histogenesis, organogenesis.

Divergent tissue differentiation.

16. Tissue regeneration, age aspects.

17. Modern ideas about stem cells.

18. Types of stem cells and their application in medicine.

19. Stem cells of bone marrow, embryonic liver, spleen. In particular: Factors regulating the development and functioning of the stem cell (microenvironment, cytokines). Colony-forming ability of stem cells in the body. Circulating pool of stem cells (peripheral blood, umbilical cord blood).

20. The doctrine of A.A. Maksimov about the stem cell. In particular: Its origin, characteristic, circulation in the body. Factors regulating the development and functioning of the stem cell. Colony-forming ability of stem cells.

21. Natural killer cells (NK cells). In particular: Definition, characteristic, markers and receptors, distribution in the body. Origin of NK cells. Regulation of the functional properties of NK cells.

22. Modern ideas about the development of blood. In particular: Embryonic hemocytopoiesis. Development of blood as a tissue (histogenesis). Postembryonic hemocytopoiesis: physiological regeneration of blood. Hemogram changes in postnatal ontogenesis. Hemogram and leukocyte formula. The concept of the Rh factor and blood groups.

23. The relationship of blood cells and loose fibrous connective tissue in immune reactions and in inflammatory reactions. In particular: Morphological phases and processes of inflammation. Cellular bases of the inflammatory reaction, the role of neutrophilic and basophilic leukocytes, monocytes. The system of mononuclear phagocytes in the human body. Cellular basis of immune reactions.

24. Monocytic-macrophage cells. In particular: Definition, characterization, markers and receptors. Role in immune processes. Development of monocytes (bone marrow stage, circulating monocytes, tissue stage of mononuclear phagocytes). A variety of functional properties of macrophages: phagocytosis, processing and representation of antigen, secretory, cytotoxic and other functions. The role of leukotrienes and prostaglandins in immune processes and in inflammation. Enzymatic activity of macrophages. Migration activity of monocytic-macrophage cells, chemotaxis. Cytokines (monokines) produced by monocytic-macrophage cells.

25. Phagocytosis of cells. In particular: The doctrine of I.I. Mechnikov about phagocytosis and inflammation. Mechanisms of phagocytosis, endocytosis, pinocytosis.

26. Dendritic cells. In particular: Determination, characteristics, receptors and markers, distribution in the body. Development of dendritic cells. Immature and mature dendritic cells, their heterogeneity. Processing and representation of

antigen. Features of dendritic cells of various localization (Langerhans cells, mucous membranes and others). Follicular dendritic cells. Isolation and evaluation of the function of dendritic cells. Mediator and other cells in immune processes.

27. Participation of cells of loose connective tissue in the protective reactions of the body and the process of wound healing. In particular: The role of fibroblasts in wound healing, scarring and granulation tissue. Causes of proliferation of connective tissue (keloid scars) in the postoperative period

28. Transformation of neurons in the process of vital activity. In particular: Age-related transformations of neurons. Features of neurons of newborns, young children, the elderly. Neuronal response to injury.

29. Modern ideas about the regeneration of nervous tissue, and ways to stimulate it.

30. Features of regeneration of cardiac muscle tissue and the possibility of its stimulation in modern medicine.

31. Influence of weightlessness and hypokinesia on the skeletal muscles of humans and animals.

32. Bone tissue regeneration, modern methods of stimulating bone repair.

33. Restructuring of bone in the process of ontogenesis. In particular: Factors affecting the structure and restructuring of bone tissue.

34. Modern ideas about the structure and regeneration of the hepatic lobule. In particular: Structural features and functional importance of liver cells. The structure of the sinusoidal hemocapillary. The ability of the liver to regenerate. Alcoholic liver damage. Restructuring of the liver in cirrhosis.

35. Features of the condition and changes of the skin in somatic and infectious diseases.

36. Age features of thin and thick skin, its epidermis and dermis. In particular: Factors that determine and accelerate the aging of the skin. Morphological features of skin vessels. Features of innervation of the skin.

37. Age-related features of changes in the tissues of the heart wall. In particular: Age-related changes in cardiac muscle tissue. Myocardial infarction, causes and morphological changes. Features of regeneration of cardiac muscle tissue and the possibility of its stimulation in modern medicine.

## Evaluation criteria for the presentation of the report:

| Evaluation                  | 50-60 points<br>(unsatisfactory)   | 61-75 points<br>(satisfactory)  | 76-85 points<br>(good)   | 86-100 points<br>(excellent)  |
|-----------------------------|--|---|--|---|
| <b>Criteria</b>             | <b>Contents</b>  |   |  |   |
| <b>Disclosure trouble</b>   | The problem is not disclosed. No conclusions                                       | The problem is not fully disclosed. No conclusions have been drawn and/or conclusions have not been substantiated | The problem is revealed. An analysis of the problem was carried out without the involvement of additional literature. Not all conclusions have been drawn and/or substantiated | The problem is fully disclosed. An analysis of the problem with the involvement of additional literature was carried out. Conclusions are justified |
| <b>Presentation</b>         | The information presented is not logically related. No professional terms used     | The information provided is not systematized and/or consistent. 1-2 professional terms used                       | The information provided is not systematized and consistent. More than 2 professional terms used   | The information presented is systematized, consistent and logically related. More than 5 professional terms used                                    |
| <b>Typography</b>           | Power Point technology is not used. More than 4 errors in the information provided | Power Point technologies are used partially. 3-4 errors in the information provided                               | Power Point technologies are used. No more than 2 errors in the information provided   | Technologies (Power Point , etc.) are widely used. There are no errors in the information provided  |
| <b>Answers to questions</b> | No answers to questions  | Only answers to elementary questions  | Answers to questions complete and/or partially complete  | Answers to the questions are complete, with ghostly examples and/or explanations  |

### **Methodical instructions for passing the exam**

The exam is taken by the leading teacher (associate professor, professor), for whom this type of educational load is assigned in an individual plan. The form of the exam is oral.

The time allowed to the student to prepare for the answer to the exam should be no more than 40 minutes. After this time, the student should be ready to respond.

The presence at the examination of unauthorized persons (except for persons carrying out the inspection) without the permission of the relevant persons (rector or vice-rector for academic affairs, director of the School, head of the OBOR or director of the department) is not allowed. Disabled persons and persons with disabilities who do not have the opportunity to move independently are allowed to take the exam with accompanying persons.

With an intermediate assessment, students are given a grade of "excellent", "good", "satisfactory" or "unsatisfactory". If the student does not appear for the exam, an entry "did not appear" is made in the statement.

### **Exam Question List**

1. The concept of "cell culture". The history of the development of methods of culturing animal and human cells. The researchers who received the first cell cultures, the first vertebrate cell cultures. The first permanent line of human cells.
2. Principles of culturing animal cells in vitro: compliance with aseptic conditions, the use of artificial nutrient media.
3. Laboratory utensils, consumables and nutrient media for cell culture. Serum and growth factors. Serum and serum-free nutrient media.
4. Monolayer and suspension cultures as the main variants of animal cell culture. Factors of cell adhesion. 2-D and 3-D cell culture.
5. Technological approaches that support aseptic conditions. Care of the workplace, requirements for working personnel. Technique of work in laminar boxing. Types of laminar cabinets (boxes), their design features and purpose.
6. Methods of sterilization of culture dishes, tools, materials, depending on the composition of the materials used for their manufacture. Types and properties of basic polymers and plastic products.
7. Sterilization of nutrient media. Modes of autoclaving of solutions and consumables. Sterilizing filtration of thermolabile components of nutrient media. Control of sterility and contamination of animal cell cultures.

8. General requirements for the laboratory for the cultivation of cells and tissues. Physical growing conditions. Growth phases of cell and tissue cultures, their characteristics.

9. What are clean rooms and how they should be organized. Cleanliness classes according to ISO.

10. Features of growing human and animal cells. Types of cell cultures depending on their origin. Features of cell cultures obtained from embryonic and mature, normal and tumor tissues.

11. Primary cultures and cell lines. Methods of tissue disaggregation: mechanical and enzymatic. Transformation of cells into permanent lines. Signs of permanent cell lines. Benefits of permanent cell lines.

12. The concept of regenerative medicine and the field of application of biomedical cell technologies. The idea and principles of the development of personalized medicine.

13. Stem cell niche. Extracellular matrix, its role. Control of cell reproduction and differentiation. The role of the extracellular matrix in regenerative medicine technologies.

14. Using animal cell cultures to solve fundamental problems in biology.

15. Use of animal and human cell cultures in pharmacy and medicine. Preparation of drugs and biologically active substances using animal cell cultures.

16. Classification of grafts and implantable cells. Classification of stem cells.

17. Principles of design and use of bioartificial extracellular matrix and its application in regenerative medicine. Print the matrix.

18. Use of human cell cultures in medicine. Principles of obtaining, using iPSCs (iPSCs).

19. Cell cycle. Mechanisms of cell cycle regulation.

20. Mechanisms of cell reproduction control and differentiation.

21. Animal Cellular Engineering. Animal cloning. Hybridization of animal cells. Reproductive and therapeutic cloning. The principle of cloning mammals, the story of Dolly the sheep.

22. Embryonic stem cells.

23. Regenerative medicine technology for the treatment of burns.

24. Assisted Reproductive Technologies (ART): The problem and causes of infertility. Basic ART techniques : In vitro fertilization (IVF), Pre-implantation genetic diagnostics (PGD), Intracytoplasmic sperm injection (ICSI).

25. Tissue printing. Biomaterials as matrixes. 3-D printing for bioartificial tissues and organs.



**Criteria for assessing students on the exam  
by discipline  
"Biomedical Cell Technologies"**

| <b>Points<br/>(rating)</b> | <b>Score of the<br/>test/exam<br/>(standard)</b> | <b>Requirements for the formed competencies</b>  |
|----------------------------|--|--|
| 100-85<br>points           | <i>"excellent" /<br/>offset</i>                  | The grade "test / excellent" is given to the student if he has deeply and firmly mastered the program material, exhaustively, consistently, clearly and logically coherently presents it, is able to closely link the theory with practice, freely copes with tasks, questions and other types of application of knowledge, and does not find it difficult to answer when modifying tasks, uses the material of monographic literature in the answer, correctly justifies the decision made, has versatile skills and techniques performing practical tasks. |
| 85-76 points               | <i>"good" / offset</i>                           | The grade "test / good" is given to the student if he firmly knows the material, correctly and substantively presents it, not allowing significant inaccuracies in the answer to the question, correctly applies theoretical provisions when solving practical questions and problems, owns the necessary skills and techniques for their implementation.  |
| 75-61 points               | <i>"satisfactory" /<br/>offset</i>               | The grade "offset / satisfactory" is given to the student if he has knowledge of only the basic material, but has not mastered its details, admits inaccuracies, insufficiently correct wording, violations of the logical sequence in the presentation of the program material, has difficulties in performing practical work.  |
| 60-50 points               | <i>"unsatisfactory" /<br/>non-offset</i>         | The grade "non-credit / unsatisfactory" is given to a student who does not know a significant part of the program material, makes significant mistakes, uncertainly, with great difficulties performs practical work. As a rule, the grade "unsatisfactory" is given to students who cannot continue their studies without additional classes in the relevant discipline.  |