



MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION  
Federal State Autonomous Educational Institution of Higher Education

**Far Eastern Federal University**  
(FEFU)


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**INSTITUTE OF LIFE SCIENCES AND BIOMEDICINE (SCHOOL)**


AGREED

Head of Educational  
Program

  
V.V. Kumeiko  
\_\_\_\_\_  
(Signed) (Surname)

CLAIM

Director of the Production Company  
Structural subdivision

  
V.V. Kumeiko  
\_\_\_\_\_  
(Signed) (Surname)  
April 12, 2023

DISCIPLINE WORK PROGRAM (RAP)

*Biomedical Cell Technologies*

*Area of study 06.03.01 Biology*

*Form of training: full-time*

*The work program is drawn up in accordance with the requirements of the Federal State Educational Standard in the field of training 06.03.01 Biology, approved by the order of the Ministry of Education and Science of the Russian Federation dated 07.08.2020 No. 9 20*

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

Director of the Department of Medical Biology and Biotechnology V.V. Kumeiko  
Authors: Candidate of Biological Sciences, Associate Professor Kumeiko V.V.

Vladivostok  
2022

1. *The work program was revised at the meeting of the Department/Department/Division (implementing the discipline) and approved at the meeting of the Department/Department/Division (graduating structural unit), minutes of "*

\_\_\_\_\_ 202 No.

2. *The work program was revised at the meeting of the Department/Department/Division (implementing the discipline) and approved at the meeting of the Department/Department/Division (graduating structural unit), minutes of "*

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## **Abstract of the discipline**

### *Biomedical Cell Technologies*

The total labor intensity of the discipline is 4 credit units / 144 academic hours. The curriculum provides for 18 hours of lectures, 18 hours of laboratory work, 36 hours of practical work, and 72 hours of independent work for the student.

**Language: Russian.**

**Objective: to** form competencies in the field of modern biomedical cell technologies, to develop students' knowledge in the field of cell biology in culture, to teach the basic modern methods of manipulation with 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. Mastering the basic methods of cell culture, working with cells in aseptic conditions, preparing culture media and additives, preparing sterile materials and laboratory glassware, 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 cell culture, evaluation 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.

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

- uses the principles of modern biotechnology, genetic engineering techniques, the basics of nanobiotechnology, molecular modeling in professional activities;
- applies methods of virological, microbiological and epidemiological analysis;
- applies modern ideas about the basics of biotechnological and biomedical

production, genetic engineering, nanobiotechnology, molecular modeling in professional activities.

As a result of studying the disciplines of molecular biology of cells, molecular and cellular biology, *methods of molecular and cell biology*, the student should be ready to study such disciplines as *bioengineering, genetic engineering, medical biotechnology*, forming competencies:

- conducts fundamental and relevant research in molecular genetics, genetic and bioengineering, and molecular and biomedical technologies;
- applies the basic concepts of the basic laws and modern methods of genetics, breeding, genomics, proteomics, in technologies for the production of pharmaceutical substances, medicines and nanotechnologies;
- applies the principles of obtaining and using enzymes, viruses, microorganisms, cell cultures of animals and plants, products of their biosynthesis.

Professional competencies of graduates and indicators of their achievement:

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

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

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

### **I. Goals and objectives of mastering the discipline**

Objective: to form competencies in the field of modern biomedical cell technologies, to develop students' knowledge in the field of cell biology in culture, to teach the basic modern methods of manipulation with 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. Mastering the basic methods of cell culture, working with cells in aseptic conditions, preparing nutrient media and additives, preparing sterile materials and laboratory glassware, 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.

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		PC-2.2 Able to apply genetic and cellular engineering methods to the development and production of medicines, medical devices, biomedical cell products and medical diagnostic systems	Knows methods of genetic and cellular engineering. Can apply genetic and cellular engineering methods. Owns the ability to obtain medicines, medical devices, biomedical cell products and medical diagnostic systems.
		PC-2.3 Able to analyze the results of an experiment in the field of biotechnology and bioengineering and carry out the development of medicines, medical devices, biomedical cell products and medical diagnostic systems	Knows Features of the development of medicines, medical devices, biomedical cell products and medical diagnostic systems. Can analyze the results of an experiment in the field of biotechnology and bioengineering Owns

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

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

The total labor intensity of the discipline is 4 credit units (1 44 academic hours), (1 credit corresponds to 36 academic hours).

The types of training and work of the student in the discipline are:

Designation	Types of Study Sessions and Student Work
Mild	Lecture
Lex electric.	
Ave	Practical exercises
Pp electric.	
Lab	Labs
WED:	Student's independent work during the period of theoretical training
	And other types of work

## III. Structure of the discipline

The form of study is full-time.

№	Section Name Discipline	S e m e s t e r	Number of hours by type of training and work of the student						Forms of intermediate attestation
			Mild	Lab	Ave	OK	WE D	Contr ol	
1	Purpose, Objectives and Theoretical Foundations of Biomedical Cell Technologies	6	9	9	18	-	45	27	Exam Questions

2	Prospects for the development and practical application of biomedical cell technologies		9	9	18	-			Exam Questions
	Total:	6	18	18	36	-	45	27	exam

## IV. CONTENT OF THE THEORETICAL PART OF THE COURSE

### Lectures

#### **Section 1. Introduction. Purpose, objectives and theoretical foundations of biomedical cell technologies.**

##### **Topic 1. Introduction. The Purpose and Objectives of Biomedical Cell Technologies.**

Concept of biomedical cell technologies. Possibilities of biomedical cell technologies. Brief historical background: A. Maksimov. L. Stevens. B. Mints et al. Possibilities of using stem cells in the clinic. Stages of implementation in medical practice.

##### **Topic 2. Theoretical Foundations of Biomedical Cell Technologies.**

Principles of stem cell differentiation. Stem cell niche. Molecular basis of pluripotency. Mechanisms of stem cell renewal. Regional stem cells. Types of stem cells. Embryonic stem cell (ESC). Hematopoietic stem cell. Stem cells from the umbilical cord blood. Mesenchymal stem cell. Targeted stem cell differentiation. Stem cell transplantation to compensate for a genetic defect. Legislation and bioethical aspects. ESQUE. The concept of totipotency and pluripotency. The main characteristics of ESCs are proliferation, self-renewal, and the absence of the G1 phase of mitosis. Behavior of ESCs in culture. Clone of ESCs. Experiments on transplantation of human ESCs to animals. Ways to obtain ESCs. Features of the ESC phenotype. ESCs to study the genomics of early embryogenesis and organogenesis. Directional differentiation of ESCs in vitro. Production of human tissues from totipotent ESCs. ESCs: Production, Differentiation, Clinical Trials. Stem and progenitor cell transplantation in medicine.

##### **Topic 3. Cell culture.**

The relevance of the use of cell cultures in various fields of biology and medicine. The possibility of their use in solving the problems of cell differentiation and proliferation. 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.**

### **Topic 1. Molecular-biological and physico-chemical methods of cell culture analysis.**

Methods of cell culture analysis: light optical, immunocytochemical, identification of cell specification markers, analysis of proliferative activity. Fundamentals of Genetic Typing of Cells. Biochip technology for elucidating the spectrum of transcribed genes in cultured cells. Physical methods for the study of cells in vitro.

### **Topic 2. Technology of paramagnetically labeled cells.**

Labeled stem cells. Nanobiomagnets to determine the migration pathways and fate of transplanted stem cells. Dendrimers as a Contrast Agent for Magnetic Resonance Imaging. Iron oxide nanoparticles for magnetic labeling of transplanted cells. Supraparamagnetic surface-carbonated iron oxide nanospheres as a contrast agent for MRI examinations. Migration Potential and Survival of Paramagnet-Labeled Transfected Cells in the Conditions of Their Transplantation. Magnetophoresis of paramagnetically labeled cells.

### **Topic 3. Biodegradable and biocompatible materials for fabric engineering structures.**

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

### **Topic 4. Biological Functional Nanosystems.**

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

tracking migration routes and the fate of stem cells in vivo, solving tissue engineering problems.

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

### **Practical exercises**

**Topic 1.** Fundamentals of Biomedical Cell Technologies.

**Topic 2.** Cell culture.

**Topic 3.** Molecular-biological and physico-chemical methods of cell culture analysis.

**Topic 4.** Technology of paramagnetically labeled cells.

**Topic 5.** Biodegradable and biocompatible materials for fabric engineering structures.

**Topic 6.** Biological Functional Nanosystems.

### **Labs**

Topic 1. Preparation of utensils, workplace, tools and solutions for the implementation of the project.

Topic 2. Preparation of culture media and biomaterials.

Topic 3. Thawing of cell cultures.

Topic 4. Cultivation of animal cells. Cell culture reseeding, cell counting.

### **Self-paced work**

Recommended topics of reports:

1. Advances in the production of recombinant antibodies
2. New biomaterial for transdermal use: in vitro and in vivo characterization.
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 iPSCs of thymic emigrants using a 3D thymus culture system.
6. Polylactic acid/collagen nanofiber scaffold 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 the biomimetic microenvironment in tissue regeneration.
9. Artificial heart muscle with or without scaffolds.
10. Neural stem cell transplantation and diseases of the central nervous system.

11. Advances in drug delivery systems, from 0 to 3D add-ons.
12. Cell cycle analysis using flow cytometry.
13. High-throughput screening of drug combinations.
14. Modeling of diseases in three-dimensional organoid systems derived from stem cells.

## VI. MONITORING THE ACHIEVEMENT OF THE COURSE OBJECTIVES

Item No.	Supervised sections/topics of the discipline	Code and name of the indicator of achievement	Learning Outcomes	Evaluation Tools	
				Current control	Intermediate Certification
1	Purpose, Objectives and Theoretical Foundations of Biomedical Cell Technologies	PC-2.1 Uses fundamental knowledge of molecular and cellular biology to put genetic and cellular engineering technologies into practice	Knows methods of biotechnology and bioengineering. Can apply biotechnology and bioengineering techniques. Owns skills in obtaining medicines, medical devices, biomedical cell products and medical diagnostic systems.	Test	Exam Questions
		PC-2.2 Able to apply genetic and cellular engineering methods to the development and production of medicines, medical devices, biomedical cell products and medical diagnostic systems	Knows methods of genetic and cellular engineering. Can apply genetic and cellular engineering methods. Owns the ability to obtain medicines, medical devices, biomedical cell products and medical diagnostic systems.	At thePoll	Exam Questions
2	Purpose, Objectives and Theoretical Foundations of Biomedical Cell Technologies	PC-2.3 Able to analyze the results of an experiment in the field of biotechnology and bioengineering and carry out the development of medicines, medical devices, biomedical cell	Knows Features of the development of medicines, medical devices, biomedical cell products and medical diagnostic systems. Can analyze the results of an experiment in the field of biotechnology and bioengineering Owns	At thePoll	Exam Questions

		products and medical diagnostic systems	skills in the development of medicines, medical devices, biomedical cell products and medical diagnostic systems.		
		PC-2.4 Able to transfer the results of research work in the field of biotechnology and bioengineering for the development and production of medicines, medical devices, biomedical cell products and medical diagnostic systems	<p>Knows Features of the development of medicines, medical devices, biomedical cell products and medical diagnostic systems.</p> <p>Can to transfer the results of research work in the field of biotechnology and bioengineering.</p> <p>Owens skills in the development of medicines, medical devices, biomedical cell products and medical diagnostic systems.</p>	Test	Exam Questions

## VII. EDUCATIONAL AND METHODOLOGICAL SUPPORT OF STUDENTS' INDEPENDENT WORK

### **Guidelines for writing and formatting an abstract**

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

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

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

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

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

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

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

Instructions for writing essays:

General requirements for the abstract:

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

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

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

The structure of the abstract should meet the standard requirements for writing essays: introduction, justification for the choice of topic, presentation of the topic, conclusion. More detailed requirements for the written design of the abstract are presented in the Procedure "Requirements for the design of written works performed by FEFU students and listeners" [http://law.wl.dvgu.ru/docs/treb\\_2012.pdf](http://law.wl.dvgu.ru/docs/treb_2012.pdf)

Approximate list of abstract topics:

1. Mechanisms of energy production in mitochondria.
2. The liver is its role in the human body.
3. Alcoholism and drug addiction are metabolic disorders.
4. Influence of trace elements on enzyme activity.

5. Metabolic connections of the Krebs cycle.
6. Types of jaundice.
7. Biotransformation of xenobiotics in the body.
8. Cholesterol fund in the human body and ways of its consumption.
9. Biological role of iron, molybdenum and zinc.

### **Criteria and Indicators Used in the Evaluation of the Educational Essay**

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

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

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

In well-made notes, it is easy to find specialized terminology that is clearly explained and clearly highlighted for memorizing the meanings of various words.



Using the outline information, it is easier to create meaningful creative or scientific works, various essays and articles.

### **Note-taking rules**

1. Read the text carefully. Along the way, mark incomprehensible places, new words, names, dates.
2. Make inquiries about the persons and events mentioned in the text. When recording, do not forget to put reference data in the fields.
3. When reading the text for the first time, make a simple outline. When re-reading, try to summarize the main points of the text, noting the author's arguments.
4. The final stage of note-taking consists of re-reading the previously marked passages and writing them down consecutively.
5. When taking notes, you should try to express the author's thought in your own words.
6. Strive to ensure that one paragraph of the author's text is conveyed in one, maximum two sentences.

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

1. Do not start writing down the material from the first words of the teacher, first listen to his thought to the end and try to understand it.
2. Start writing at the moment when the teacher, having finished the presentation of one idea, begins to comment on it.
3. In the synopsis, it is necessary to highlight individual parts. It is necessary to distinguish between headings, subheadings, conclusions, to separate one topic from another. Selection can be done with an underline or a different color (just don't turn the text into colorful pictures). It is recommended to indent paragraphs and points of the plan, white lines to separate one thought from another, and numbering. If definitions, formulas, rules, and laws can be made more visible in the text, they are framed. Over time, you'll have your own selection system.
4. Create your entries using accepted conventions. When taking notes, be sure to use a variety of signs (they are called signal signs). These can be pointers and directional arrows, exclamation and question marks, combinations PS (afterword) and NB (pay attention). For example, you can denote the word "therefore" with a mathematical arrow  $\Rightarrow$ . Once you've developed your own character set, it's easier and faster to create an outline and then study it.
5. Don't forget about abbreviations (abbreviated words), equal and inequality signs, more and less.
6. Abbreviations are very useful for creating a correct outline. Be careful, though. Connoisseurs believe that abbreviations such as "d-t" (to think) and similar

ones should not be used, since later a large amount of time is spent on deciphering, and after all, the reading of the synopsis should not be interrupted by extraneous actions and reflections. The best thing to do is to develop your own system of abbreviations and use them to denote the same words (and nothing else) in all entries. For example, the abbreviation "g-t" will always and everywhere be the word "to speak," and the capital "P" will be the word "work."

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

8. Complex and lengthy reasoning should be avoided.

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

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

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

#### **Evaluation criteria:**

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

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

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

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

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

### Reference citations

1. Studenikina T.M., Vylegzhanina T.A., Ostrovskaya T.I., Stelmakh I.A.; edited 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: Textbook for Secondary Professional Education / E. M. Lenchenko. - 2nd ed., ispr. i dop. —

Moscow: Yurayt Publishing House, 2023. — 347 p. — (Professional education). — ISBN 978-5-534-08617-1. — Text : electronic // Educational platform Urait [site]. — URL: <https://urait.ru/bcode/514046>

3. Polyakova T. I., Sukhov I. B. Biology of cells: textbook. — St. Petersburg: St. Petersburg Medical and Social Institute, 2015. — 56 p. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: <https://www.iprbookshop.ru/74246.html>

4. Ivanishchev V. V. Molecularheskaya biologiya: uchebnik [Molecular biology: textbook]. — 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. Dvoretzkiy. - 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. Konichev A. S., Sevastyanova G. A., Tsvetkov I. L. Molecular Biology: Textbook for Higher Educational Institutions. - 5th ed. - Moscow: Yurayt Publishing House, 2023. — 422 p. — (Higher education). — ISBN 978-5-534-13468-1. — Text : electronic // Educational platform Urait [site]. — URL: <https://urait.ru/bcode/517095>

7. Ershov, Y. A. A. Ershov, N. I. Zaitseva; edited by S. I. Shchukin. - 2nd ed., ispr. i dop. — Moscow: Yurayt Publishing House, 2023. — 323 p. — (Professional education). — ISBN 978-5-534-10400-4. — Text : electronic // Educational platform Urait [site]. — URL: <https://urait.ru/bcode/517755>

#### Further reading

1. New biomedical technologies with the use of biologically active additives. Vol. 2 / Far Eastern Scientific Center for Physiology and Pathology of Breathing of the Siberian Branch of the Russian Academy of Medical Sciences, Research Institute of Medical Climatology and Rehabilitation; [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 a 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. Gene-cell biotechnologies of the XXI century and man / V.Z. Tarantul // Russia and the modern world. – № 1 – 2009. P. 188-203. <http://lib.dvfu.ru:8080/lib/item?id=chamo:641555&theme=FEFU>
4. Romanovskiy G.B., Tarusina N.N., Mokhov A.A. Biomeditsinskiy pravo v Rossii i za rubezh [Biomedical law in Russia and abroad]. Moscow: Prospekt Publ., 2016. – 364 p. <http://lib.dvfu.ru:8080/lib/item?id=chamo:813279&theme=FEFU>
5. Stem Cell Biology and Cell Technologies: for Medical Universities in 2 vols.: vol. 1 / M.A. Paltsev, R.S. Akchurin, M.A. Aleksandrova [i dr.]; Ed. by M. A. Paltsev. Moscow: Medicine, Shiko, 2009. 272 p. (in Russian). <http://lib.dvfu.ru:8080/lib/item?id=chamo:779352&theme=FEFU>
6. Stem Cell Biology and Cell Technologies: for Medical Universities in 2 vols.: vol. 2 / M.A. Paltsev, R.S. Akchurin, M.A. Aleksandrova [et al.]; edited by M. A. Paltsev. Moscow: Meditsina, Shiko, 2009. 455 p. (in Russian). <http://lib.dvfu.ru:8080/lib/item?id=chamo:779355&theme=FEFU>

#### List of information technologies and software

1. Microsoft Office Professional Plus 2013 is an office suite that includes software for working with various types of documents (texts, spreadsheets, databases, etc.);
2. 7Zip 16.04 is a free file archiver with a high compression ratio;
3. Adobe Acrobat XI Pro – a software package for creating and viewing electronic publications in PDF format;
4. AutoCAD Electrical 2015 – three-dimensional computer-aided design and drafting system;
5. ESET Endpoint Security 5 – comprehensive protection for Windows-based workstations. Virtualization support + new technologies;
6. WinDjView 2.0.2 – a program for recognizing and viewing files with the same DJV and DjVu formats; SolidWorks 2016 is a CAD software package for automating the work of an industrial enterprise at the stages of design and technological preparation of production
7. Compass-3D LT V12 – Three-Dimensional Simulation System
8. Notepad++ 6.68 – Text Editor

## **IX. METHODOICAL INSTRUCTIONS FOR MASTERING THE DISCIPLINE**

### **Lecture**

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

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

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

#### **Lecture – visualization**

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

#### **Lecture-conversation**

Lecture-conversation, "dialogue with the audience", is the most common form of active learning and allows students to be involved in the educational process, since there is direct contact between the teacher and the audience. Such contact is achieved

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

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

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

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

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

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

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

*The case* study is designed to increase the effectiveness of educational activities: as an illustration for solving a certain problem, explaining a particular phenomenon, studying the features of its manifestations in real life, developing competence aimed at solving various life and work situations (the use of the case involves individual and group work of students).

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

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

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

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

## Quizzes & Testing

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

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

## LOGISTICAL SUPPORT FOR DISCIPLINE

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

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

### Logistical and software of the discipline

Name of special rooms and rooms for independent work	Equipment special rooms and rooms for self-study	List of licensed software. Details of the supporting document
690922, Primorsky Krai, Vladivostok, Russky Island, Saperny Peninsula, Ajax village, 10, aud. M 605	<p>Multimedia audience:                      Electric Screen 236*147cm Trim Screen Line; DLP Projector, 3000 ANSI Lm, WXGA 1280x800, 2000:1 EW330U Mitsubishi; CORSA-2007 Tuarex Specialized Equipment Fastening Subsystem; Video Switching Subsystem: Extron DXP 44 DVI Pro DVI Matrix Switcher; Extron DVI 201 Tx/Rx twisted-pair DVI extender Audio switching and sound amplification subsystem; Extron SI 3CT LP ceiling mount speaker system; Extron DMP 44 LC Digital Audio Processor; Extension for IPL T CR48 control controller; Wireless LAN for students is provided by a system based on 802.11a/b/g/n 2x 2 MIMO (2SS) access points.                      Моноблок HP ProOne 400 All-in-One 19.5 (1600x900), Core i3-4150T, 4GB DDR3-1600 (1x4GB), 1TB HDD 7200 SATA, DVD+/-RW, GigEth, Wi-Fi, BT, usb kbd/mse, Win7Pro (64-bit) +Win8.1Pro(64-bit), 1-1-1 Wty</p>	-
690922, Primorsky Krai, Vladivostok, Russky Island, Saperny Peninsula, Ajax village, 10, aud. M 422	<p>Multimedia audience:                      HP ProOne 400 G1 AiO 19.5" Intel Core i3-4130T 4GB DDR3-1600 SODIMM (1x4GB)500GB; Projection screen Projecta Elpro Electrol, 300x173 cm; Multimedia projector,</p>	-



	<p>Mitsubishi FD630U, 4000 ANSI Lumen, 1920x1080; Mortise interface with TLS TAM 201 Stan automatic cable retraction; Avervision CP355AF visualizer; Sennheiser EW 122 G3 UHF microphone lavalier radio system consisting of wireless microphone and receiver; Video conferencing codec LifeSizeExpress 220- Codeonly- Non-AES; Multipix MP-HD718 Network Video Camera; Two 47" Full HD LG M4716CCBA LCD panels; Audio switching and sound reinforcement subsystem; Centralized uninterrupted power supply</p>	
<p>690922, Primorsky Krai, Vladivostok, Russky Island, Saperny Peninsula, Ajax village, 10, aud. M 627</p>	<p>Light microscope Carl Zeiss GmbH Primo Star 3144014501 (13 pcs.); Light microscope with digital camera Altami BIO8 (2 pcs.).</p>	-
<p>Computer class of the School of Biomedicine aud. M723, 15 workplaces</p>	<p>Electric Screen 236*147cm Trim Screen Line; DLP projector, 3000 ANSI Lm, WXGA 1280x800, 2000:1 EW330U Mitsubishi; CORSA-2007 Tuarex Specialized Equipment Fastening Subsystem; Video Switching Subsystem: Extron DXP 44 DVI Pro DVI Matrix Switcher; Extron DVI 201 Tx/Rx twisted-pair DVI extender Audio switching and sound amplification subsystem; Extron SI 3CT LP Ceiling Mount Speaker System Extron DMP 44 LC Digital Audio Processor; extension for IPL T CR48 control controller; Wireless LAN for students is provided by a system based on 802.11a/b/g/n 2x2 MIMO(2SS) access points. Monoblock HP RgoOpe 400 All-in-One 19.5 (1600x900), Core and3-4150T, 4GB DDR3-1600 (1x4GB), 1TB HDD 7200 SATA, DVD+/-RW, GigEth, Wi- Fi, VT, usb kbd/mse, Win7Pro (64-bit)+Win8.1Pro(64-bit), 1-1-1 Wty</p>	-