

**Federal State Autonomous Educational Institution of Higher Education "Moscow  
Institute of Physics and Technology  
(National Research University)"**

**APPROVED**  
**Head of the Phystech School of  
Biological and Medical Physics**  
**D.V. Kuzmin**

**Work program of the course (training module)**

**course:** Pathophysiology/Патофизиология  
**major:** Biotechnology  
**specialization:** Biomedical Engineering/Биомедицинская инженерия  
Phystech School of Biological and Medical Physics  
Center for educational programs in bioinformatics  
**term:** 4  
**qualification:** Bachelor

Semester, form of interim assessment: 8 (spring) - Exam

Academic hours: 30 AH in total, including:

lectures: 0 AH.

seminars: 30 AH.

laboratory practical: 0 AH.

Independent work: 75 AH.

Exam preparation: 30 AH.

In total: 135 AH, credits in total: 3

Authors of the program:

A.S. Dukh

O.Y. Belogurova-Ovchinnikova, phd (candidate of biological sciences)

The program was discussed at the Center for educational programs in bioinformatics 04.06.2020

## Annotation

The goal of the discipline is the formation of basic knowledge about fundamental physicochemical and biological processes in a living cell. The result of training is the following knowledge, skills and abilities: memorization and understanding of the basic terms used in cell biology; the ability to explain how a certain biological process occurs; the ability to make quantitative estimates of quantities used in modeling processes in a cell; understanding of standard research methods and their limits of applicability. The knowledge gained at the end of the course is necessary for the full study of other disciplines in the field of biophysics.

### 1. Study objective

#### Purpose of the course

- formation of basic knowledge of cellular and molecular biology and understanding of fundamental physicochemical and biological processes occurring in a living cell, for their subsequent use in a more detailed study of other biological and biochemical disciplines;
- the formation of biological culture and the ability to apply biological knowledge in practice.

#### Tasks of the course

- to form basic knowledge of cellular and molecular biology;
- to form an understanding of the fundamental physicochemical and biological processes occurring in a living cell, an understanding of the interaction of cells, the results of this interaction, as well as possible dysfunctions of both individual cellular processes and their totality;
- to form a biological culture: to instill knowledge of the basic concepts of cell biology, the principles of the structure and composition of the cell; to acquaint with the methods of studying cells and their macromolecules, teach to correctly pose and formulate questions in the study of biological disciplines, both theoretical and practical;
- to form skills and contribute to the development of skills to apply the knowledge gained in independent, including research, work, solving problems, as well as analyzing the results.

### 2. List of the planned results of the course (training module), correlated with the planned results of the mastering the educational program

Mastering the discipline is aimed at the formation of the following competencies:

Code and the name of the competence	Competency indicators
UC-1 Search and identify, critically assess, and synthesize information, apply a systematic approach to problem-solving	UC-1.1 Analyze problems, highlight the stages of their solution, plan the actions required to solve them
	UC-1.2 Find, critically assess, and select information required for the task in hand
	UC-1.3 Consider various options for solving a problem, assess the advantages and disadvantages of each option
	UC-1.4 Make competent judgments and estimates supported by logic and reasoning
	UC-1.5 Identify and evaluate practical consequences of possible solutions to a problem
Gen.Pro.C-2 Use modern IT and software tools to perform professional tasks in compliance with information security requirements	Gen.Pro.C-2.1 Apply modern computing tools and Internet services in professional settings
	Gen.Pro.C-2.2 Apply numerical mathematical methods and use software applications for scientific problem-solving in professional settings
	Gen.Pro.C-2.3 Fulfill basic information security requirements
Gen.Pro.C-5 Participate in fundamental and applied research and development activities; independently develop new theoretical research methods (including mathematical research methods)	Gen.Pro.C-5.1 Perform tasks in the field of theoretical and experimental research and development activities
	Gen.Pro.C-5.2 Apply new knowledge through the study of literature, scientific articles, and other sources

### 3. List of the planned results of the course (training module)

As a result of studying the course the student should:

know:

- basic concepts and definitions;
- types of cells, their similarities, features and differences;
- the main cellular organelles, their structure and functions, pathologies associated with organelle dysfunctions;
- cell transport, cell transport systems, molecular mechanisms of the process;
- systems of cell reception and signaling;
- interaction of cells on the example of immunity and carcinogenesis.

be able to:

- work with scientific literature on biological topics, including scientific articles and reviews,
- competently formulate an experimental problem, propose ideas for its solution, as well as assume possible results and analyze the actual results.

master:

- knowledge about the theoretical foundations of experimental techniques and manipulations with cells, as well as basic cell macromolecules (proteins, nucleic acids).

#### **4. Content of the course (training module), structured by topics (sections), indicating the number of allocated academic hours and types of training sessions**

##### **4.1. The sections of the course (training module) and the complexity of the types of training sessions**

№	Topic (section) of the course	Types of training sessions, including independent work			
		Lectures	Seminars	Laboratory practical	Independent work
1	Introduction		4		10
2	Cell pathophysiology		4		10
3	General reactions of the body to damage		4		10
4	Allergy. Autoimmune Disorders		5		10
5	Inflammation		4		11
6	Fever		4		12
7	Pathophysiology of internal organs		5		12
AH in total			30		75
Exam preparation		30 AH.			
Total complexity		135 AH., credits in total 3			

##### **4.2. Content of the course (training module), structured by topics (sections)**

Semester: 8 (Spring)

###### **1. Introduction**

Causes and mechanisms of functional and biochemical disorders underlying the disease. Mechanisms of adaptation and restoration of functions impaired in disease (mechanisms of recovery).

###### **2. Cell pathophysiology**

Types of damage and cell death. The universal response of a cell to damage. Mechanisms of damage to cell membrane structures.

### 3. General reactions of the body to damage

General adaptation syndrome. Acute phase reactions. Shock. Coma.

### 4. Allergy. Autoimmune Disorders

Allergy. Pseudo-allergic reactions. Autoimmune disorders.

### 5. Inflammation

Basic theories of inflammation. Inflammation etiology. Experimental reproduction of inflammation. The pathogenesis of inflammation. Chronic inflammation. General manifestations of inflammation. The role of reactivity in inflammation. Types of inflammation. The course of inflammation. Inflammation outcomes. The importance of inflammation for the body.

### 6. Fever

Ontogenesis of fever. Etiology and pathogenesis of fever. Fever stages. Fever types. Fever metabolism. The work of organs and systems with fever. The biological significance of fever. Feverlike conditions. The difference between fever and overheating. The principles of antipyretic therapy.

### 7. Pathophysiology of internal organs

Pathological changes in the blood system are detected in morphological and functional disorders in organs participating in the processes of hematopoiesis and blood destruction, as well as in disorders of their regulation as a result of the direct action of various damaging factors, in a number of infectious diseases and in the actual diseases of the blood system.

## **5. Description of the material and technical facilities that are necessary for the implementation of the educational process of the course (training module)**

Classroom equipped with a computer and multimedia equipment (projector, sound system).

## **6. List of the main and additional literature, that is necessary for the course (training module) mastering**

### Main literature

Provided at the base department:

Pathophysiology: textbook: in 2 volumes / ed. V.V. Novitsky, E. D. Goldberg, O. I. Urazova. - 4th ed., Rev. and add. - GEOTAR-Media, 2009. -- T. 1. - 848 p. : ill.

### Additional literature

## **7. List of web resources that are necessary for the course (training module) mastering**

Not used

## **8. List of information technologies used for implementation of the educational process, including a list of software and information reference systems (if necessary)**

For some of the lessons, you will need Zoom. Google Drive to access course materials. The presence of smartphones / laptops during classes is encouraged to participate in interactive exercises.

## **9. Guidelines for students to master the course**

A student studying a discipline must, on the one hand, master the general conceptual apparatus, and on the other hand, must learn to apply theoretical knowledge in practice.

As a result of studying the discipline, the student must know the basic definitions of the discipline, be able to apply the knowledge gained to solve various problems.

Successful completion of the course requires:

- attendance of all classes provided for by the curriculum for the discipline;
- keeping a synopsis of classes;
- student's intense independent work.

Independent work includes:

- reading recommended literature;
- study of educational material, preparation of answers to questions intended for independent study;
- solving problems offered to students in the classroom;
- preparation for the performance of tasks of the current and intermediate certification.

An indicator of mastery of the material is the ability to answer questions on the topics of the discipline without a synopsis.

It is important to achieve an understanding of the material being studied, not its mechanical memorization. If you find it difficult to study certain topics, questions, you should seek advice from a teacher.

Intermediate control of students' knowledge is possible in the form of solving problems in accordance with the topic of classes.

**Assessment funds for course (training module)**

**major:** Biotechnology  
**specialization:** Biomedical Engineering/Биомедицинская инженерия  
Phystech School of Biological and Medical Physics  
Center for educational programs in bioinformatics  
**term:** 4  
**qualification:** Bachelor

Semester, form of interim assessment: 8 (spring) - Exam

**Authors:**

A.S. Dukh  
O.Y. Belogurova-Ovchinnikova, phd (candidate of biological sciences)

## 1. Competencies formed during the process of studying the course

Code and the name of the competence	Competency indicators
UC-1 Search and identify, critically assess, and synthesize information, apply a systematic approach to problem-solving	UC-1.1 Analyze problems, highlight the stages of their solution, plan the actions required to solve them
	UC-1.2 Find, critically assess, and select information required for the task in hand
	UC-1.3 Consider various options for solving a problem, assess the advantages and disadvantages of each option
	UC-1.4 Make competent judgments and estimates supported by logic and reasoning
	UC-1.5 Identify and evaluate practical consequences of possible solutions to a problem
Gen.Pro.C-2 Use modern IT and software tools to perform professional tasks in compliance with information security requirements	Gen.Pro.C-2.1 Apply modern computing tools and Internet services in professional settings
	Gen.Pro.C-2.2 Apply numerical mathematical methods and use software applications for scientific problem-solving in professional settings
	Gen.Pro.C-2.3 Fulfill basic information security requirements
Gen.Pro.C-5 Participate in fundamental and applied research and development activities; independently develop new theoretical research methods (including mathematical research methods)	Gen.Pro.C-5.1 Perform tasks in the field of theoretical and experimental research and development activities
	Gen.Pro.C-5.2 Apply new knowledge through the study of literature, scientific articles, and other sources

## 2. Competency assessment indicators

As a result of studying the course the student should:

### know:

- basic concepts and definitions;
- types of cells, their similarities, features and differences;
- the main cellular organelles, their structure and functions, pathologies associated with organelle dysfunctions;
- cell transport, cell transport systems, molecular mechanisms of the process;
- systems of cell reception and signaling;
- interaction of cells on the example of immunity and carcinogenesis.

### be able to:

- work with scientific literature on biological topics, including scientific articles and reviews,
- competently formulate an experimental problem, propose ideas for its solution, as well as assume possible results and analyze the actual results.

### master:

- knowledge about the theoretical foundations of experimental techniques and manipulations with cells, as well as basic cell macromolecules (proteins, nucleic acids).

## 3. List of typical control tasks used to evaluate knowledge and skills

During the current control, the student should be able to answer the following questions:

Development of pathophysiology in Russia. Main scientific schools.

The action of pathogenic factors of the external environment.

The role of heredity, constitution and age in pathology.

Reactivity and resistance of the organism, their role in pathology.

Pathophysiology of immunity.

Pathophysiology of peripheral (organ) circulation and microcirculation.

Pathophysiology of typical metabolic disorders.

Pathophysiology of tissue growth.

During classes, interactive discussions can take place in the course chats, which will be homework. It is possible to perform patent search as an independent task. Successful completion of all tasks in the course and completion of knowledge control slices gives an advantage in the exam.

#### 4. Evaluation criteria

Development of pathophysiology in Russia. Main scientific schools.

The action of pathogenic factors of the external environment.

The role of heredity, constitution and age in pathology.

Reactivity and resistance of the organism, their role in pathology.

Pathophysiology of immunity.

Pathophysiology of peripheral (organ) circulation and microcirculation.

Pathophysiology of typical metabolic disorders.

Pathophysiology of tissue growth.

Sample tickets:

Ticket 1.

The main task of pathophysiology.

Theoretical development of philosophical and methodological problems of pathology, its fundamental concepts and categories.

Ticket 2.

Definition of the concept of "pathogenesis".

Local and general, specific and nonspecific reactions in pathogenesis.

The mark is excellent (10 points) - it is given to a student who has shown comprehensive, systematic, deep knowledge of the curriculum of the discipline, who has an interest in this subject area, has demonstrated the ability to confidently and creatively put them into practice in solving specific problems, and a free and proper substantiation of decisions.

The mark is excellent (9 points) - it is given to a student who has shown comprehensive, systematic, in-depth knowledge of the curriculum of the discipline and the ability to confidently put them into practice in solving specific problems, free and proper substantiation of the decisions made.

The mark is excellent (8 points) - given to a student who has shown comprehensive, systematic, in-depth knowledge of the curriculum of the discipline and the ability to confidently apply them in practice in solving specific problems, correct justification of decisions made, with some shortcomings.

A mark is good (7 points) - it is put up for a student, if he knows the material firmly, sets it up competently and in essence, knows how to apply the knowledge gained in practice, but does not competently substantiate the results obtained.

Evaluation is good (6 points) - it is put up to a student, if he knows the material firmly, sets it up correctly and in essence, knows how to apply this knowledge in practice, but admits some inaccuracies in the answer or in solving problems.

A mark is good (5 points) - it is given to a student, if he basically knows the material, correctly and essentially sets it out, knows how to apply this knowledge in practice, but allows a sufficiently large number of inaccuracies to answer or solve problems.

Grade satisfactorily (4 points) is given to a student who has shown the fragmented, fragmented nature of knowledge, insufficiently correct formulations of basic concepts, violations of the logical sequence in the presentation of program material, but at the same time he has mastered the main sections of the curriculum necessary for further education and can apply knowledge is modeled in a standard situation.

Grade satisfactorily (3 points) - given to a student who showed the fragmented, scattered nature of knowledge, making mistakes in formulating basic concepts, disrupting the logical sequence in presenting program material, poorly masters the main sections of the curriculum required for further education and even applies the knowledge gained in a standard situation.



The rating is unsatisfactory (2 points) - is given to a student who does not know most of the main content of the curriculum of the discipline, makes gross mistakes in the wording of the basic principles and does not know how to use this knowledge when solving typical tasks.

Unsatisfactory mark (1 point) - is given to a student who does not know the main content of the discipline's curriculum, makes gross errors in the wording of the basic concepts of the discipline and does not have any skills to solve typical practical problems.

## **5. Methodological materials defining the procedures for the assessment of knowledge, skills, abilities and/or experience**

When conducting an oral exam, the student is given 60 minutes to prepare. The poll of a student on a ticket for an oral exam should not exceed one astronomical hour.