

Discipline	Medical and Biological Physics
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Consultations	According to the schedule
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1. Discipline annotation \ General information about the discipline

Medical and Biological Physics is a fundamental medical and biological discipline that studies living objects and the human body in particular, based on physical phenomena and processes that determine their functioning, and underlie diagnostic, therapeutic and preventive methods of medicine.

The discipline comprises three main sections:

- I. Fundamentals of mathematical modeling of living systems and mathematical processing of medical and biological data
- II. Fundamentals of Biological Physics
- III. Fundamentals of Medical Physics

The discipline is taught in the first year of study within the 1st semester.

2. Background of the discipline

The given course on Medical and Biological Physics is based on knowledge of physics, mathematics, chemistry, and biology in accordance with the secondary school program.

3. Goal and objectives of the discipline

The goal of the Medical and Biological Physics is to provide students with a comprehensive set of general scientific, fundamental physical and biophysical knowledge required to understand medical and biological phenomena and to acquire corresponding specialized expertise in practical medicine.

Key objectives of the Medical and Biological Physics are:

- to learn methods of mathematical modeling and statistical processing of medical and biological information;
- to explore biophysical basics of human body systems functioning in norm and pathology;
- to study the mechanisms of influence of physical environmental factors on the human body at the micro and macro levels of living organization;
- to learn physical and technical basics of diagnostic, treatment and preventive methods of medicine, medical equipment operations.

4. Learning outcomes

Expected results of learning Medical and Biological Physics include:

- provision of students with a comprehensive system of physical and biophysical knowledge in order to understand phenomena and regularities of vital activities of the living organisms and the human body at all levels of their organization;
- proficiency in methods of mathematical modeling and statistical processing of medical and biological information;
- knowledge of mechanisms of influence of physical environmental factors on the human body;
- knowledge of physical and technical basics of diagnostic, treatment, and preventive methods of medicine;
- skills in medical equipment operations;
- ability to conduct theoretical and practical research based on the synthesis of mathematical and fundamental natural medical and biological knowledge;
- ability to solve common and specialized complex biomedical problems.

As well as:

Knowledge:

- of biophysical factors and mechanisms of human body systems functioning in norm and pathology, biophysical factors and mechanisms of etiology and pathogenesis of certain diseases;

Ability:

- to apply acquired physical and biophysical knowledge
- to model problem situations based on the systematic analysis and mathematical processing of medical and biological data

5. ECTS credits**4 credits / 120 hours****6. Structure of the Discipline**

Topics	Type of classes / hours		
	Lectures	Practice	Self-study
Section 1. Fundamentals of mathematical modeling of living systems and mathematical processing of medical and biological data			
1. Fundamentals of Calculus.	2	6	2
2. Fundamentals of the Theory of Differential Equations.	2	3	2
3. Modelling of dynamic processes with the use of Differential Equations.	2	3	2
4. Fundamentals of Probability Theory and Mathematical Statistics.	2	3	2
Section 2. Fundamentals of Biological Physics			
5. Fundamentals of Molecular Biophysics.	2	3	2
6. Fundamentals of Biological Thermodynamics.	2	3	2
7. Biophysics of membrane processes.	2		4
8. Membrane Potentials. Action Potential.	2	3	2
Section 3. Fundamentals of Medical Physics			
9. Bioacoustics. Biophysics of Hearing.	2	3	2
10. Fundamentals of Biorheology.	2	3	2
11. Fundamentals of Hemodynamics.	2	3	4
12. Fundamentals of Biological Electrodynamics. Electrography.	2	3	2
13. Fundamentals of Rheography.	2		4
14. Physical bases of Physiotherapy.	2	3	2
15. Biological optics. Optical methods in Medicine.	2	3	2
16. Physical bases of Radiology. Radiation safety.	2	3	4
Graded Test.		3	
Total	32	48	40

7. Mandatory tasks

Task	Deadline
1. Application of the differential to approximate calculations and measurement error evaluation.	According to the schedule
2. Application of the definite integral to calculate areas and volumes of figures, and estimation of averages.	According to the schedule
3. Application of the theory of differential equations to describe vibration and wave processes.	According to the schedule
4. Modeling of population dynamics, epidemiology, and pharmacokinetics models.	According to the schedule
5. Application of probability theory methods and statistical analysis of medical and biological data.	According to the schedule
6. Surface tension and its biological importance.	
7. Modeling and calculation of membrane potentials.	According to the schedule
8. Modeling of elastic properties of biological tissues.	According to the schedule
9. Modeling and calculation of hemodynamics parameters.	According to the schedule
10. Determining of liquid viscosity.	According to the schedule
11. Determining of blood viscosity in clinic.	According to the schedule
12. Calculation of hemodynamic parameters on the base of rheogram data.	According to the schedule
13. Modeling of biological tissues impedance.	According to the schedule
14. Processing of cardiogram data.	According to the schedule
15. Determining of the threshold of hearing with the use of audiometric method.	According to the schedule
16. Determining of physical effects of physiotherapy.	According to the schedule
17. Optical methods of determining of biological liquid properties.	According to the schedule
18. Biological effect of ionizing radiation.	According to the schedule

8. Elective tasks

Task	Deadline
1. Calculation of errors of indirect measurements.	According to the schedule
2. Calculation of the mean arterial pressure.	According to the schedule
3. Diffusion and heat conductivity equations, their physical and biological nature.	According to the schedule
4. Wave processes in living systems.	According to the schedule
5. Predator-prey population dynamics model.	According to the schedule
6. Mathematical models in epidemiology.	According to the schedule
7. Pharmacokinetics models.	According to the schedule
8. Bayes' Theorem and its clinical applications.	According to the schedule
9. Normal law of random distribution.	According to the schedule
10. Evaluation and calculation of thermodynamic potentials.	According to the schedule
11. The first law of Thermodynamics and its biological meaning. Calculation of body energy balance.	According to the schedule
12. Neurotransmission.	According to the schedule
13. Biophysical models of muscular contraction.	According to the schedule
14. Biophysics of cardiac muscle.	According to the schedule
15. Modeling of hemodynamic processes.	According to the schedule
16. Ultrasonic methods of diagnostics.	According to the schedule
17. Blood viscosity and its clinical meaning.	According to the schedule
18. Physical principles of electrocardiography.	According to the schedule
19. Electrography of organs and body tissues.	According to the schedule
20. Magnetocardiography.	According to the schedule
21. Eye as an optical system. Biophysics of vision.	According to the schedule
22. Radiography methods.	According to the schedule
23. Magnetic resonance imaging.	According to the schedule
24. Calculation of radiation safety parameters.	According to the schedule

9. Signs of the Discipline

Term of teaching	Semester	Interdisciplinary integration	Year of study	Cycles General Professional Electives
One semester, 16 weeks	1st	Medical Biology	1	General
		Anatomy	1	General
		Histology	1	General
		Biological and Bioorganic Chemistry	1	General
		Physiology	2	General
		Medical Informatics	2	General
		Hygiene and Ecology	3	Professional
		Ophthalmology	4	Professional
		Neurology	4	Professional
		Otolaryngology	4	Professional
		Anesthesiology	5	Professional
		Radiology	5	Professional
		Emergency medicine	2	Elective
		Biostatistics	2	Elective
		Instrumental methods in diagnostic	6	Elective
		Medical equipment	1	Elective

10. Hardware and software / Equipment

Computers, interactive boards / equipment for the laboratory practice, medical devices and technical means.

11. Assessment system and requirements.

Overall discipline assessment:

Current student performance is assessed due to the 4-point grading scale (2; 3; 4; 5) at each practical (seminar, laboratory) class.

The final test on the discipline "Medical and Biological Physics" is carried out in the form of a graded test. The graded test on the discipline is conducted in the form of a written test on individual variants, each of which contains 3 theoretical questions and one problem.

Written work requirements

Practical tasks and homework assignments should be prepared in a written form and provided to the lecturer for checking and assessment.

Students are admitted sitting the final graded test if they do not have missed or undone practical classes, and if their average current grade is at least 3 points due to the 4-point scale \ 120 points due to the 200-point scale.

12. Discipline policy

The learning process on Medical and Biological Physics is supposed compliance with the rules that ensure effective mastery of the subject, both in theory and on practice, namely:

- lecturer and students are present in the classroom in accordance with the schedule, and the established time mode
- students attend classes regularly without missing
- lecturer and students are neatly dressed in appropriate clothing, namely in a white lab coat while the class time
- lecturer lays out the course fully in the line with the curriculum of the discipline
- students lead notes of lectures and practices
- the learning of the discipline is based on a team spirit, cooperation, and solidarity of the lecturer with the students
- subject issues are discussed in the form of free discussion between lecturer and students, and among students themselves
- lectures and practical classes conducting, except for the final test, involves independent work of students with use of information technology, and respective means of processing, storage and transmission of information,

including computers, personal gadgets, and other electronic devices, as well as textbooks, manuals, methodical developments, etc.

- scientific research work of students is welcome
- essay writing is essential, and obligatory part of the learning process, and self-study
- topics of the subject matter is considered in terms of their practical importance and bioethical consistency
- mutual behavior of lecturer and students in classroom and in extracurricular time has to follow the generally accepted norms and patterns of behavior, which provide mutual respect, collegial way of relationships, and excludes religious, racial, ethnic, cultural, age, gender, social, political, and other prejudices, as well as bullying, sexual harassment, and other manifestations and forms of intolerance, and humiliation of human dignity
- any signs of corruption in the learning process, made by lecturer or by students are unacceptable

13. Absence policy

- class attendance is obligatory
- missed classes should be reworked according to the schedule

14. Task performance policy

Tasks completed after the deadline without valid reasons are assessed with respect to the delay, but not greater than 75% of the maximum number of points for a corresponding task.

15. Academic integrity policy

Participants of the educational process rely on the academic integrity principles according to the Code of Academic Integrity of academic, scientific and teaching staff and students of International European University (<https://ieu.edu.ua/pro-mieu/publiczna-informatsiia>)

16. Recommended sources of information

1. Medical and Biological Physics. Part I / [V.I. Fediv, O.I. Olar, O.Y. Mykytiuk and others]. Textbook for students of higher medical education institutions – Chernivtsi: BSMU Publishing House, 2016. - 205 p.
2. Medical and Biological Physics. Part II / [V.I. Fediv, O.I. Olar, O.Y. Mykytiuk, V.F. Boiechko]. Textbook for students of higher medical

education institutions – Chernivtsi: BSMU Publishing House, 2017. - 235 p.

3. Medical and Biological Physics. Textbook for students of higher medical education institutions / V.I. Fediv, O.I. Olar, V.V. Kulchynskyi, H. Y. Rudko. – Chernivtsi: BSMU Publishing House, 2017. - 342 p. – English.
4. Irving P. Herman. Physics of the Human Body. / Springer – Verlag. Berlin, Heidelberg 2007.

17. Tips on successful study during the course

- Class attendance
- Dialogue with the lecturer regarding the educational program issues
- Accomplishment of tasks according to the program
- Essay writing on program topics
- Discussion of topics and tasks in groups in the out-of-class time
- Usage of online resources