



# Biophysics

<b>1. IMPRINT</b>	
<b>Academic Year</b>	2023/2024
<b>Department</b>	Faculty of Medicine
<b>Field of study</b>	Medicine
<b>Main scientific discipline</b>	Medical sciences
<b>Study Profile</b>	General academic
<b>Level of studies</b>	Uniform MSc
<b>Form of studies</b>	Full time studies
<b>Type of module / course</b>	Obligatory
<b>Form of verification of learning outcomes</b>	Credit
<b>Educational Unit / Educational Units</b>	Department of Biophysics, Physiology and Pathophysiology Faculty of Health Sciences, Medical University of Warsaw, 5 Chałubińskiego Str., 02-004 Warsaw  phone: +48 22 6286334 phone/fax: +48 22 6287846
<b>Head of Educational Unit / Heads of Educational Units</b>	Dariusz Szukiewicz, PhD, DSc, ProfTit
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<b>Person responsible for syllabus</b>	Piotr Jeleń, MSc, PhD e-mail: piotr.jelen@wum.edu.pl phone: +48 22 6286334
<b>Teachers</b>	Dariusz Szukiewicz, PhD, DSc, ProfTit Maria Sobol, PhD, DSc Agnieszka Malinowska, MSc, PhD Maciej Pylak, MSc, PhD Piotr Jeleń, MSc, PhD

<b>2. BASIC INFORMATION</b>			
<b>Year and semester of studies</b>		<b>Number of ECTS credits</b>	3.00
<b>FORMS OF CLASSES</b>		<b>Number of hours</b>	<b>ECTS credits calculation</b>
<b>Contacting hours with academic teacher</b>			
Lecture (L)		4	0.16
Seminar (S)		15	0.60
Discussions (D)			
e-learning (e-L)			
Practical classes (PC)		15	0.60
Work placement (WP)			
<b>Unassisted student's work</b>			
Preparation for classes and completions		41	1.64

<b>3. COURSE OBJECTIVES</b>	
O1	Physics of human body
O2	Impact of physical factors on human body
O3	Physical bases of chosen imaging and therapeutic techniques in medicine

<b>4. STANDARDS OF LEARNING – DETAILED DESCRIPTION OF EFFECTS OF LEARNING</b>	
<b>Code and number of the effect of learning in accordance with standards of learning</b>	<b>Effects in time</b>
<b>Knowledge – Graduate* knows and understands:</b>	
B.W5	laws of physics referring to fluid flow and the determinants of resistance to blood flow;
B.W6	natural and artificial sources of ionising radiation and the mechanisms of interaction of ionising radiation with matter;
B.W7	physicochemical and molecular basis of the functioning of sensory organs;
B.W8	physical bases of non-invasive imaging techniques;

B.W9	physical bases of the chosen therapeutic techniques including ultrasounds and irradiations;
<b>Skills– Graduate* is able to:</b>	
B.U1	apply physical phenomena to explain the effects of external factors, such as temperature, acceleration, pressure, electromagnetic field and ionising radiation on the human organism and its components;
B.U2	assess the health effects of absorption of a given dose of ionising radiation and observe the radiation protection rules;
B.U9	use the basic measurement equipment and assess the precision of the measurements;

\* In appendix to the Regulation of Minister of Science and Higher education from 26th of July 2019 „graduate”, not student is mentioned.

<b>5. ADDITIONAL EFFECTS OF LEARNING (non-compulsory)</b>	
<b>Number of effect of learning</b>	<b>Effects of learning i time</b>
<b>Knowledge – Graduate knows and understands:</b>	
<b>Skills– Graduate is able to:</b>	
<b>Social Competencies – Graduate is ready for:</b>	

<b>6. CLASSES</b>		
<b>Form of class</b>	<b>Class contents</b>	<b>Effects of Learning</b>
Lecture L1	Biophysics in contemporary medicine.	B.W5, B.W6, B.W7, B.W8, B.W9
Lecture L2	The basics of ionising radiation and radiation protection	B.W6, B.W9
Seminar S1	Introduction to thermodynamics. Biological membranes (passive and active transport across a cell membrane, resting membrane potential, action potential).	B.W7, B.U1
Seminar S2	Biophysics of circulation (basic physical laws of fluid flow, types of fluids in fluid mechanics, laminar, turbulent and pulsatile flow, blood circulation system, physical properties of blood and blood vessels).	B.W5
Seminar S3	Heart electrical activity (genesis of ECG, heart axis).	B.W8, B.U9
Seminar S4	Respiratory biophysics (structure of the lungs, mechanics of breathing, respiratory cycle, gas flow in airways partial pressures of gases). Spirometry (pulmonary volumes and capacities). Respiration under usual and unusual conditions.	B.W5, B.U1, B.U9
Seminar S5	Imaging techniques in medicine (CT, PET, SPECT, MRI).	B.W8
Practical class PC1	Sound waves. Physical bases of hearing. Audiometry screening and interpretation.	B.W7, B.U1, B.U9

Practical class PC2	Physical basics of ultrasonography.	B.W8, B.U9
Practical class PC3	Doppler ultrasonography. Blood flow characteristics in arteries.	B.W5, B.W8, B.U9
Practical class PC4	Biophysics of vision (image formation in the human eye, eye accommodation, vision defects and their correction, eyepiece magnification).	B.W7, B.U9
Practical class PC5	X rays – measurements and interpretation. Health effects of ionizing radiation absorption. Principles of radiological protection.	B.W6, B.W9, BU2, B.U9

## 7. LITERATURE

### Obligatory

1. Daviodovits P.: Physics in Biology and Medicine (5-th ed.), Academic Press, 2018.
2. Herman I.P.: Physics of the Human Body, Springer, Berlin-Heidelberg-New York, 2016.
3. Ronto G., Tarjan I. (Eds.): An Introduction to Biophysics with Medical Orientation, (3rd ed.), Akadémiai Publishing Company, Budapest, 1999.

### Supplementary

1. Glaser, R.: Biophysics, Springer-Verlag 2005.
2. Hobbie R.K., Roth B.J.: Intermediate Physics for Medicine & Biology (5-th ed.), Springer International Publishing AG, 2015.
3. Malmivuo J., Plonsey R.: Bioelectromagnetism, - Principles and Applications of Bioelectric and Biomagnetic Fields. New York, Oxford University Press, 1995.
4. Samuel J. Ling, Truman State University, Jeff Sanny, Loyola Marymount University William Moebs formerly of Loyola Marymount University (senior contributing authors)  
University Physics (Vol 1, Vol 2, Vol 3) Access for free at [openstax.org](https://openstax.org).

## 8. VERIFYING THE EFFECT OF LEARNING

Code of the course effect of learning	Ways of verifying the effect of learning	Completion criterion
B.W5	Quiz, written report, final test	threshold number of points: 60 %
B.W6	Quiz, written report, final test	threshold number of points: 60 %
B.W7	Quiz, written report, final test	threshold number of points: 60 %
B.W8	Quiz, written report, final test	threshold number of points: 60 %
B.W9	Quiz, written report, final test	threshold number of points: 60 %

B.U1	Positive assessment of the skills acquired during the classes conducted by the teacher	sufficient skill acquisition assessed by a teacher
B.U2	Positive assessment of the skills acquired during the classes conducted by the teacher	sufficient skill acquisition assessed by a teacher
B.U9	Positive assessment of the skills acquired during the classes conducted by the teacher	sufficient skill acquisition assessed by a teacher

## 9. ADDITIONAL INFORMATION

Before the first meeting students should check on the website of Department of Biophysics, Physiology and Pathophysiology which group they belong to and what is the order of seminars/experiments in that group (see "Division into Groups" and "Schedule"). If the sequence is changed this fact will be announced on the website.

Students belong to particular groups according to the division provided by the Dean's Office (it is not a matter of free choice). Students can change their groups only at the beginning of the course in justified cases.

Before laboratory classes, students should read and understand the relevant instructions available on the e-learning platform. At the beginning of laboratory classes students can expect an introduction given by the teacher. Then the experiment / (demonstration) will be performed. Finally, students receive a form of an experimental report with the instructions to be followed and the questions to be answered. The report should be signed by a student. The form should be returned to the teacher before the end of the meeting. Students are assessed on basis of the results of their reports. The results should be available for the students the next week.

Students' achievements are graded based on the final test results covering all material from lectures, seminars and practical classes. The test will be composed of 60 questions. To be admitted to the final test students are obliged to fulfil the following conditions:

- attend all seminars and practical classes,
- pass all of the quizzes on the e-learning platform (after each lecture and seminar students should complete a short quiz; to pass the quiz, student has to answer correctly at least 60 % of the questions),
- submit 5 experimental reports and collect at least 15 points (one experimental report would be assessed for maximum 5 points).

To pass the final test, the student has to answer correctly at least 60% of the questions.

Rules of grading:

grade	criteria
2.0 (failed)	0-35 correct answers
3.0 (satisfactory)	36-40 correct answers
3.5 (rather good)	41-45 correct answers
4.0 (good)	46-50 correct answers
4.5 (more than good)	51-55 correct answers
5.0 (very good)	56-60 correct answers

Students who fail the test may retake it. There are two (and only two!) chances of repeating the final test.

All absences must be excused (e.g., sick leave) and made up with another group of students after consultation with the teacher. The further detailed information for students will be available on the website of the Department of Biophysics, Physiology and Pathophysiology.

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**ATTENTION**

The final 10 minutes of the last class of the block/semester/year should be allotted for students to fill out the Survey of Evaluation of Classes and Academic Teachers