Biophysics

1. IMPRINT

Academic Year	2025/2026
Department	Faculty of Medicine
Field of study	Medicine
Main scientific discipline	Medical sciences
Study Profile	General academic
Level of studies	Uniform MSc
Form of studies	Full time studies
Type of module / course	Obligatory
Form of verification of learning outcomes	Credit
Educational Unit / Educational Units	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
Head of Educational Unit / Heads of Educational Units	Dariusz Szukiewicz, PhD, DSc, ProfTit
Course coordinator	Piotr Jeleń, MSc, PhD e-mail: piotr.jelen@wum.edu.pl phone: +48 22 6286334
Person responsible for syllabus	Piotr Jeleń, MSc, PhD e-mail: piotr.jelen@wum.edu.pl phone: +48 22 6286334
Teachers	Dariusz Szukiewicz, PhD, DSc, ProfTit Maria Sobol, PhD, DSc Agnieszka Malinowska, MSc, PhD

	Maciej Pylak, MSc, PhD Piotr Jeleń, MSc, PhD

2. BASIC INFORMATION

Year and semester of studies	second semester of the first year	**Number of ECTS credits**	2,00

FORMS OF CLASSES **Contacting hours with academic teacher**	**Number of hours**	**ECTS credits calculation**
Lecture (L)	5	0.17
Seminar (S)	10	0,33
Classes (C)		
e-learning (e-L)		
Practical classes (PC)	15	0,50
Work placement (WP)		
Unassisted student's work		
Preparation for classes and completions	30	1,00

3. COURSE OBJECTIVES

O1	Physics of human body
O2	Impact of physical factors on human body
O3	Physical bases of chosen imaging and therapeutic techniques in medicine

4. STANDARDS OF LEARNING – DETAILED DESCRIPTION OF EFFECTS OF LEARNING

Code and number of the effect of learning in accordance with standards of learning	**Effects in the field of:** *(in accordance with appendix to the Regulation of Minister of Science and Higher education from 26th of July 2019)*

Knowledge – Graduate* knows and understands:	
B.W4	physical laws describing fluid flow and factors affecting vascular resistance to blood flow;
B.W5	natural and artificial sources of ionising radiation and their interaction with matter;
B.W6	the physico-chemical and molecular basis of the sensory organs;
B.W7	the physical basis of non-invasive imaging methods;
B.W8	the physical basis of selected therapeutic techniques;
Skills– Graduate* is able to:	
B.U1	use knowledge of the laws of physics to explain the effects of external factors such as temperature, acceleration, pressure, electromagnetic fields and ionising radiation on the human body;
B.U2	assess the effect of ionising radiation dose on normal and pathologically altered tissues of the body and comply with the principles of radiological protection;

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

5. ADDITIONAL EFFECTS OF LEARNING *(non-compulsory)*

Number of effect of learning	**Effects in the fields of:**
Knowledge – Graduate knows and understands:	
Skills– Graduate is able to:	
Social Competencies – Graduate is ready for:	

6. CLASSES

Form of class	**Class contents**	**Effects of Learning**
Lecture L1	Biophysics in contemporary medicine.	B.W4, B.W5, B.W6, B.W7, B.W8
Lecture L2	The basics of ionising radiation and radiation protection	B.W5, B.W8
Seminar S1	Introduction to thermodynamics. Biological membranes (passive and active transport across a cell membrane, resting membrane potential, action potential).	B.W6, 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.W4

Seminar S3	Heart electrical activity (genesis of ECG, heart axis).	B.W7
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.W4, B.U1
Seminar S5	Imaging techniques in medicine (CT, PET, SPECT, MRI).	B.W7
Practical class PC1	Sound waves. Physical bases of hearing. Audiometry screening and interpretation.	B.W6, B.U1
Practical class PC2	Physical basics of ultrasonography.	B.W7
Practical class PC3	Doppler ultrasonography. Blood flow characteristics in arteries.	B.W4, B.W7
Practical class PC4	Biophysics of vision (image formation in the human eye, eye accommodation, vision defects and their correction, eyepiece magnification).	B.W6
Practical class PC5	X rays – measurements and interpretation. Health effects of ionizing radiation absorption. Principles of radiological protection.	B.W5, B.W8, BU2

7. LITERATURE

Obligatory

1. Daviodovits P.: Physics in Biology and Medicine (6-th ed.), Academic Press, 2024.

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, (4th ed.), Akadémiai Publishing Company, Budapest, 2003.

Supplementary

1. Glaser, R.: Biophysics, Springer-Verlag 2012.

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.

8. VERIFYING THE EFFECT OF LEARNING

Code of the course effect of learning	Ways of verifying the effect of learning	Completion criterion

B.W4	Quiz, written report, final test	threshold score: 60 %
B.W5	Quiz, written report, final test	threshold score: 60 %
B.W6	Quiz, written report, final test	threshold score: 60 %
B.W7	Quiz, written report, final test	threshold score: 60 %
B.W8	Quiz, written report, final test	threshold score: 60 %
B.U1	Positive assessment of the skills acquired during the classes	sufficient skill acquisition assessed by a teacher
B.U2	Positive assessment of the skills acquired during the classes	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.

Prior to the laboratory activities, students should read and understand the relevant instructions available on the e-learning platform. At the beginning of laboratory class students can expect an introduction by the teacher. This will be followed by an experiment / (demonstration). Finally, students will receive a form of an experiment 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 to students on the e-learning platform the following week.

Students' achievements are graded based on the final written 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. According to Study Regulations of the Medical University of Warsaw there is only one re-test.
However, in the event of failure to obtain a credit in the course on the first and second attempts the student may submit an application to the Dean within 7 days from the date of crediting for additional test.

All absences must be excused (e.g., sick leave) and made up with another group of students. The exact date should be agreed with the course coordinator. Only timetabled dates are available. In a situation where a student was absent but provided a medical certificate and could not make up the missed class because it was the last class related to the topic, the student may agree with the teacher another form of making up the absence. The teacher may have the student prepare a written paper on the given topic and then check the student's knowledge orally. The teacher may also require to take an additional written test on a given topic (60% of correct answers are required to pass the test).

If in doubt or if problems arise, please contact the course coordinator: piotr.jelen@wum.edu.pl

Every Wednesday after the last practical class, one of the teachers will be on duty for 30 minutes (16:30-17:00) to help students with ongoing problems.

The further detailed information for students will be available on the website of the Department of Biophysics, Physiology and Pathophysiology.

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