Załącznik nr 5 do zarządzenia nr 189/2025

COURSE SPECIFICATION

Course code: 0912.4.LEK.B.Bp

Course title in Polish: Biofizyka
Course title in English: Biophysics

1. Placement of the course within the study programme

1.1. Field of study	Medicine
1.2. Mode of study	Full-time
1.3. Level of study	Uniform Master's study
1.4. Profile of study	General academic
1.5. Course specification author	Prof. dr hab. Tadeusz Kosztołowicz
1.6. Contact	tadeusz.kosztolowicz@ujk.edu.pl

2. Generał characteristics of the course

2.1. Language of instruction	English
2.2. Entry requirements	The basics of physics in the scope of the secondary school

3. Detailed characteristics of the course

3.1. Type of classes	Lectures: 25h, classes: 10h, laboratories:10h
3.2. Place of course delivery	Courses in the teaching rooms of the UJK
3.3. Form of assessment	Exam/ Credit with grade
3.4. Teaching methods	Lectures: Informative lecture, problem-based lecture. Classes: Classical problem-based method, research method. Laboratories: Laboratory exercises.
3.5.a. Basic reading list	1. Davidovits Paul, Physics in Biology and Medicine, Elsevier, 2024. 2. R.K. Hobbie, B.J. Roth, Intermediate Physics for Medicine and Biology, Springer, 2015.
3.5.b. Supplementary reading list	1. Cotterill Rodney, Biophysics an Introduction, John Wiley & Sons, 2002. 2. Glaser Roland, Biophysics, Springer Verlag, 2012

4. Objectives, content and learning outcomes

4.1. Course objectives (taking into account the form of classes)

Lectures

- **CO1.** Understanding the physical basis of the mechanisms that governs physiological processes in living organisms.
- **CO2.** Familiarizing with the physical basis of the functioning of organs and organ systems of the human body.

Classes

- **CO1.** Acquiring the knowledge of physical methods in medical research.
- **CO2.** Acquiring the ability to perform biophysical calculations.

Laboratories

- **CO1.** Acquiring the ability to plan and conduct simple biophysical experiments.
- **CO2.** Acquiring the ability to process, analyze, and interpret experimental results.

4.2. Course content (taking into count the form of classes)

Lectures

Basic concepts in mechanics. Static forces. Equilibrium and stability. Stability of human body. Skeletal muscles. Levers, the elbow, the hip, the back. Translational and angular motion. Friction. Vertical jump. Energy consumed in physical activity. Forces on curved path. Pendulum. Energy in running. Elasticity of materials. Longitudinal stretch and compression. A spring. Bone fracture. Fracture due to fall. Fluids. Force and pressure in fluid. Pascal's principle. Archimedes' principle. Surface tension. Motion of fluids. Bernoulli's equation. Viscosity and Poiseuille's law. Turbulent flow. Circulation of the blood. Blood pressure. Power produced by the heart. Heat and kinetic theory. Kinetic theory of matter. Transfer of heat. Diffusion. Diffusion through membranes. The respiratory system. First and second laws of thermodynamics. Thermodynamics of living systems. Energy requirements of people. Energy from food. Regulation of body temperature. Convection, radiation, evaporation. Waves and sound. Properties of waves, reflection, refraction, interference, diffraction. Hearing and the ear. Doppler effect. Basic concepts in electricity and magnetism. The nervous system. Physiological effects of electricity. Basic concepts in optics. Nature of light. Structure of the eye. Lens system of the eye. Accommodation. Defects in vision. Atomic and nuclear physics. The atom model. Spectroscopy. Ultrasonic waves. Clinical uses of sound. Electrical technology in medical research. The electrocardiograph, the electroencephalograph. X-rays. Radiation therapy. Nuclear magnetic resonance.

Classes

Solving exercises related to: mechanics of the human body, blood flow and pressure, respiratory system, energy balance, thermodynamics, heat flow, diffusion of substances, acoustic waves, system of lens, electricity and magnetism.

Laboratories

The students perform 3-4 exercises from the following list:

1. Determining surface tension of liquids with the application of torsion balance.
2. Study of inviscid flow. Testing Bernoulli's principle.
3. Study of electrical potentials in membrane systems.
4. Study of the magnetic field using the Hall probe.
5. Study of diffraction and absorption of ultrasonic waves.
6. Study of polarization of light. Testing the Malus law.

4.3. Course learning outcomes

Course learning outcomes (code)	Upon completion of the course, the student	Alignment with programme learning outcomes
in the area of knowledge knows and understands:		
W01	The physical laws describing the flow of fluids and factors affecting the vascular resistance of blood flow;	B.W4.
W02	Natural and artificial sources of ionizing radiation and its interaction with the matter;	B.W5.
W03	The physical, chemical and molecular basis of how the organs of the senses function;	B.W6.
W04	The physical basis of non-invasive imaging methods;	B.W7.
W05	The physical principles of selected therapeutic techniques;	B.W8.

W06	The possibilities of modern telemedicine as a tool to support the work of a physician;	B.W25.

in the area of skills knows how to:

U01	Use the knowledge of the laws of physics to explain the impact of external factors such as temperature, acceleration, pressure, electromagnetic fields and ionizing radiation on the body and its elements;	B.U1.
U02	Assess harmful ionizing radiation dose on normal as well as diseased body tissues and adhere to the principles of radiation protection;	B.U2.
U03	Use medical databases and properly interpret the information contained therein necessary to solve problems in the field of basic and clinical sciences;	B.U8.
U04	Classify the methodology of scientific research, including distinguishing between experimental and observational studies, along with their subtypes, rank them according to the reliability of the provided results and correctly assess the quality of scientific evidence;	B.U10.
U05	Plan and perform basic scientific research, interpret the results and draw conclusions;	B.U11.
U06	Use basic laboratory and molecular techniques;	B.U12.

in the area of social competences is able to:

K01	Recognize his/her own limitations and self-evaluate educational deficiencies and needs;	K.S5.
K02	Use reliable information sources;	K.S7.
K03	Conclude on the basis of own surveys and observations;	K.S8.
K04	Introduce rules of social conduct and teamwork to the group of specialists, including specialists form other medical professions also in the multicultural and multinational environment;	K.S9.
K05	Give opinions concerning various aspects of professional activity;	K.S10.
K06	Take responsibility for own decisions made during professional activities including own safety and safety of other people.	K.S11.

4.4. Assessment methods for learning outcomes

Assessment method (+/-)

Course learning outcomes (code)	Oral/written/ practical examinaion /other (specify)*	Test*	Project*	In-class activity*	Independent study*	Group work*	Other (specify)*

Type of classes

1: / 2:	L	C	Lab	L	C	Lab	L	C	Lab	L	C	Lab	L	C	Lab	L	C	Lab	L	C	Lab
W01-W06	+				+					+	+	+	+	+	+			+			
U01-U06	+				+					+	+	+	+	+	+			+			
K01-K06	+				+					+	+	+	+	+	+			+			

Annotation. 1: form of classes; 2: learning outcomes

4.5. Assessment criteria for learning outcomes

Type of classes:

LECTURE (L) (including classes conducted with the use of distance learning methods and techniques)

Grade	Assessment criteria
3,0	Receiving 61-68% of the points available
3,5	Receiving 69-76% of the points available
4,0	Receiving 77-84% of the points available
4,5	Receiving 85-92% of the points available
5,0	Receiving 93-100% of the points available

Type of classes:

CLASSES (C) (including classes conducted with the use of distance learning methods and techniques)

Grade	Assessment criteria
3,0	Receiving 61-68% of the points available
3,5	Receiving 69-76% of the points available
4,0	Receiving 77-84% of the points available
4,5	Receiving 85-92% of the points available
5,0	Receiving 93-100% of the points available

Type of classes:

LABORATORIES (Lab) (including classes conducted with the use of distance learning methods and techniques)

Grade	Assessment criteria
3,0	Receiving 61-68% of the points available
3,5	Receiving 69-76% of the points available
4,0	Receiving 77-84% of the points available
4,5	Receiving 85-92% of the points available
5,0	Receiving 93-100% of the points available

5. ECTS credit allocation – student workload

Category	Student workload (full-time mode)	Student workload (part-time mode)
NUMBER OF HOURS WITH THE DIRECT PARTICIPATION OF THE TEACHER (CONTACT HOURS)	**45**	
Participation in lectures*	25	
Participation in seminars/laboratories*	20	
Other (specify) e.g. classes conducted with the use of distance learning methods and techniques*		
INDEPENDENT STUDY (NON-CONTACT HOURS)	**50**	
Preparation for lectures*	25	
Preparation for seminars/laboratories*	25	
Preparation for examination/test*		
Gathering materials for project, online research*		
Preparation of a multimedia presentation*		
Other (specify)*		

TOTAL HOURS	**95**	
ECTS CREDITS for the course	**4**	

*** delete as appropriate**

Approved for implementation (date and legible signatures of course instructors in the given academic year):

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