GENERAL INFORMATION		
Course	**Physics and Biophysics**	
Course coordinator	**Asst. Prof. Hrvoje Brkić, PhD**	
Assistant/Associate	Prof. Igor Đerđ, PhD Asst. Prof. Bojan Resan, PhD Ivana Krpan, Assistent Ana Ivković, Assistent	
Study Programme	**Integrated undergraduate and graduate university study of Medicine in German language**	
Status of the course	Mandatory	
Year of study, semester	1st year, 1st semester	
Grading scale and workload	ECTS	**6**
	Hours (L+S+E)	**70** (30+20+20)

COURSE DESCRIPTION

Course objectives

Introducing students to basic concepts of physics and their application to biological systems. Acquisition of knowledge and skills related to force and motion, optics and optical devices, electricity and magnetism, spectroscopy basics, hydrodynamics and hydrostatics, radioactivity and electromagnetic spectrum, thermodynamics, vibration, sound and ultrasonic waves, and their application in medicine and physiology. The aim is to encourage an analytical, quantitative approach in the study of the functions of the human body.

Enrolment requirements and entry competencies

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Learning outcomes at the Program level

1.1, 2.1

Learning outcomes (5-10)

Knowledge

1. Mastering the fundamentals of physics to understand the application of physical laws in biological systems and fundamentals of biological processes at the molecular level
2. Understand physical quantities and units used in biophysics and medical physics
3. Explain basic principles of quantum mechanics and apply them to atomic and molecular structure
4. Explain basic concepts of mechanics and hydromechanics and apply them to the human body
5. Explain and define basic concepts and laws of thermodynamics and use them to explain the behavior of the human body as a thermodynamic system
6. Explain the transmission of nerve signals using basic concepts of electromagnetism and thermodynamics
7. To describe and explain interaction mechanisms between ion radiation and substances and the effect that ion radiation can have on humans, as well as to recognize the importance and the field of activity of dosimetry and to define doses
8. Explain the laws of optics and apply them to the propagation and nature of light, the formation of images in the eye and optical devices and the correction of optical errors in the eye using glasses.
9. define and explain vibrations of mechanical systems; to apply it to the description of

sound waves and to explain the relationship between acoustic parameters and physiological sensations of sound waves

Skills

S1. Acquire basic laboratory skills

S2. Use simple measuring devices and be able to interpret the results

Course content

Overview of teaching. Distribution of seminars.

Basic mathematical functions in biology and medicine. (L)
Linear function. Reciprocal Interdependence. Exponential function. Logarithmic function. Periodic function: harmonic and non-harmonic. Vectors and operations on vectors. differential calculus.

Introduction to conducting practical laboratory exercises. (P)
Overview of the laboratory exercises. Statistical and electronic data processing and written technical reporting.

Atomic and Molecular Structure. (L)
Structure and stability of the atomic nucleus. Radioactivity. Molecular structure. Covalent, ionic and polar bond. energy states in the molecule.

Electromagnetic radiation. (L)
Dual properties of electromagnetic radiation (experiment). Interaction between electromagnetic radiation and matter. absorption law. Introduction to spectroscopy. Spectroscopy Types. Application of radioactivity and electromagnetic waves in medicine.

History of radioactivity. (S)
Use and Dangers. Application in medicine. Principles of radiation protection. Dosimetry and practical examples. Medical radiation. Perception about radioactivity in the general population. Solving numerical tasks.

Concept of power and energy. (L)
Movement of solid bodies. Body energy. Newton's Laws. Movement and deformation of solid bodies under the action of a force. Centripetal and centrifugal force, application in medicine. Lever; Translational and rotational balance. Types of levers in the human body.

Body mechanics. (S)
Special cases (lifting loads, movement on ice, long jump, high jump...). Solving numerical tasks from kinematics and mechanics.

Hydrostatics and hydrodynamics. (L)
Physics of gases and application example in medicine. Pressure. Pascal's Law, Hydrostatic Pressure, Buoyancy, Bernoulli's Law, Poiseuille's Law. Flow properties of blood. Simple examples of applying the basic laws of hydrostatics and hydrodynamics to the human body.

Hydrostatics and hydrodynamics. (S)
Solving numerical tasks. Hydrodynamic Experiments.

Consolidation of the learned material. (S)
Repetition. Predefined questions for a discussion in the seminar. Solving numerical tasks. Small written test of the learned material.

Determination of the viscosity of an unknown liquid. (P)
Properties of a liquid based on the measured viscosity and comparison with other liquids.

Determination of the surface tension of an unknown liquid. (P)
Properties of a liquid based on the measured viscosity and comparison with other liquids.

Determination of the flow rate of liquids. (P)
Bernoulli's law.

Introduction to electricity and magnetism. (L)
Electric and magnetic field. Polarization. Induction. Action potential. Physical basics ECG, EEG and EEG.

Matter in the electric and magnetic field. (S)
Matter in the static and dynamic electric field; Mechanisms of polarization of tissues. matter in static and dynamic magnetic fields; Magnetic properties of matter. Mechanisms of tissue heating in electricity, dynamic magnetic and electromagnetic fields. Practical examples and experiments.

Electrical circuits. (P)
Units and handling of measuring instruments.

Determination of humidity. (P)
Determination by psychrometer measurements or mathematically from psychometric curves.

Vibrations as the source of the wave. sound wave. (L)
Propagation of the sound wave in space. audiometry; isophonic curves. Intensity level dB. Volume. Relationship between physical and physiological parameters.

Oscilloscope determination of the frequency and pulse strength of a cardiac pacemaker. (P)
Handling of measuring instruments. Oscilloscope, determination of the frequency and volume of sound.

Ultrasonic. (L)
Operation and design of an ultrasonic device. Physical basics. Doppler effect. Operation and design of an ultrasound device using a Doppler effect. Physical limitations of an ultrasound machine.

Ultrasonic. (P)
Practical examples and demonstration exercises on the device. Volume and body surface determination of different acoustic impedances in the phantom using an ultrasound device.

Optics. (L)
Electromagnetic waves; Refraction, reflection, diffraction, dispersion. Geometric optics. Propagation of light in space. Diopter: flat, spherical and combination of diopter. Lenses. Mirror.

Determination of the object thickness using a microscope. (P)
Aperture of the microscope.

Eye model. (S)
Accommodation and visual defects of the eye. optical microscope. Image structure and creation. resolution of a microscope. Types of microscopes. solving numerical tasks.

Thermodynamics. (L)
Laws of thermodynamics. Thermodynamics of biological systems. energy transfer. Practical example of energy transfer due to different temperatures and numerical problem solving.

Mass transfer. (S)
Diffusion. Osmosis. Nernst equation in biology, chemistry, physics, physiology. Resolution of numerical tasks.

Consolidation of the learned material. (S)
Repetition. Predefined questions for a discussion in the seminar. Solving numerical tasks. Small written exam of the learned material.

Mode of teaching	☒lectures ☒seminars and workshops ☒exercises ☐distance education ☐field teaching	☒independent tasks ☒multimedia and network ☐laboratory ☐mentoring work ☐other

Student obligations

Students are expected to attend all class sessions, as well as to take all the examinations. However, they are allowed for excused absences, totalling 30% of all classes.

Monitoring student work

Attending classes	x	Class activity	x	Seminar work		Experimental work	
Written exam	x	Oral exam	x	Essay		Research	
Project		Continuous knowledge verification		Paper		Practical work	x
Portfolio							

Grading and evaluation of student work during classes and of the final examination

Teaching activity	ECTS	Learning outcome	Student activity	Assessment methods	Grade points	
					Min.	Max.
Attendance	0,5	1-9	Attendance	Evidence	0	0
Pracitical	1,0	S1, S2	Presence and active participation in exercises	Exercise log, knowledge check	0	10
Seminars	1	1-9	Solving simple problems independently, solving simple tasks, short written checks	Essay, records of resolved tasks, short written checks	0	10
Written exam	3,5	1-9	Study	Written exam	0	40
Total	**6**				**0**	**60**

Calculation of final grade:
(1) practical exam – Students will do 6 practical exercises during class, for each repot can receive up to 1 point
(2) written exam - 40 multiple-answer questions
(3) seminar
a) Problem - creating a seminar on a given task - maximum 3 points. The seminar is presented, in the term provided for, seminars can be theoretical or practical
b) Participation in classes during lectures - maximum 1 point

c) Written checks on knowledge during class - maximum 6 points

Criteria:
36-41 sufficient (2)
42-47 good (3)
48-53 very good (4)
54-60 excellent (5)

Required reading

1. Ulrich Harten: Physik für Mediziner ISBN 978-3-662-61355-9 ISBN 978-3-662-61356-6 https://doi.org/10.1007/978-3-662-61356-6
2. Literature from physics department in Merlin system

Additional reading

1. D. C. Giancoli: Physics: Principles with Applications, Sixth Edition, Prentice Hall, Inc., 2004. ISBN: 0130606200.
2. Volker Harms, Dr. med., Physik für Mediziner und Pharmazeuten, ISBN: 978-3-86026-230-6.
3. Physikpaket: Physik für Mediziner und Pharmazeuten: Lehrbuch und Übungsbuch zusammen als Paket zum reduzierten Preis Taschenbuch – von Volker Harms

Number of copies of required literature in relation to the number of students currently attending classes in the course

Title	Number of copies	Number of students
Ulrich Harten: Physik für Mediziner	*20*	
Literature from physics department in Merlin system	*merlin.srce.hr*	

Course evaluation procedures

Anonymous, quantitative, standardized student survey providing feedback on the course as well as on the work of course coordinators and their assistants/associates is being conducted by the QA Office of the Faculty of medicine Osijek.