PHYSICS AND BIOPHYSICS	
GENERAL INFORMATIONS	
Course coordinator	Asst. Prof. Hrvoje Brkić, MPhys, PhD
Assistant/Associate	Prof. Dario Faj, MPhys, PhD Asst. Prof. Mladen Kasabašić, MPhys, PhD Ana Ivković, , MPhys, PhD Ivana Krpan, MPhys
Study Programme	Undergraduate University Study of Medical Laboratory Diagnostics
Status of the course	mandatory
Year of study, semester	1st year, 2nd semester
ECTS	**5**
Workload (hours)	Lecture: 15; Seminars: 10; Laboratory exercises: 25
Expected number of students	30-35
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 and operation of diagnostic devices.	
Enrolment requirements and entry competencies	
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Learning outcomes at the Programme level	
1.1, 1.2, 2.6, 2.7	
Learning outcomes at the course level	
After completing lectures, seminars and exercises, independent study and passing the exam, students will be able to: 1. formulate basic physical laws and apply them in biological systems. 2. interpret the physical basics of biological processes at the molecular level. 3. interpret the mechanisms of action of biological systems based on knowledge of basic physical laws using simple models. 4. interpret the physical basics of diagnostic and therapeutic methods in medical and laboratory diagnostics. 5. handle simpler measuring instruments and be able to interpret results. 6. apply the acquired knowledge in the field of physics in practice and independently continue to expand your knowledge in this field.	
Course content	
Lectures: Basic mathematical functions in biology and medicine: Linear. Reciprocal addiction. It's exponential. Logarithmic. Periodic: harmonic and nonharmonic. Vectors and vector operations. Differential account. Structure of atoms and molecules: The structure and stability of the atomic nucleus. Radioactivity. The structure of the molecule. Covalent, ion and polar bindings. Energy states in the molecule. Electromagnetic radiation. Types of electromagnetic radiation. Dual properties of EM light (experiment). Interaction between electromagnetic radiation and matter. Optics: Electromagnetic wave; breakage reflection, edging, dispersion. Geometric optics. Spreading light through space. Diopters: flat, spherical and diopter combinations. Lens. Mirrors.	

Physical optics

Notion of force and energy: The motion of solid bodies. The energy of the body. Newton's laws. Motion and deformation of solid bodies under the action of force. Centripetal and centrifugal force, use in medicine, experiment. Lever; translational and rotational balance. Types of levers in the human body.

Hydrostatics and hydrodynamics: Gas physics and an example of application in medicine. Pressure. Pascal's Law, hydrostatic pressure, buoyancy, Bernoulli's Law, Poissel Law. Rheological properties of the blood. Simpler examples of the application of basic laws of hydrostatics and hydrodynamics to the human body.

Introduction to electricity and magnetism: Electric and magnetic field. Polarization. Induction. Action potential. Physical basics ECG, EEG and EEG. Tissues in the electric and magnetic fields. Tissue in a permanent and variable electric field; mechanisms of tissue polarization. Tissue in a constant and variable magnetic field; magnetic properties of the substance. T

Thermodynamics: Basic laws of thermodynamics. Thermodynamics of biological systems. Energy transport. A practical example of energy transfer due to different temperatures and numerical problem solving. Mass transfer. Diffusion. Osmosis. Nernst equation in biology, chemistry, physics, physiology

Source of the wave: Sound wave. Spreading a sound wave through space. Audiometry; isophone curves. Intensity level. dB. Volume level. Relationship between physical and physiological parameters

Seminars: Structure of atoms and molecules: The law of absorption. Ionizing radiation. Solving the numerical problems Introduction to spectroscopy. Types of spectroscopy. The use of radioactivity and EM waves in medical laboratory diagnostics. Emission spectroscopy, spectroscopy devices

Mechanics. Centrifuge, Lever, Incline, Crane, Archimedus law, law of communicating vessels

Introduction to electricity and magnetism: Tissue heating mechanisms in a variable electrical, variable magnetic and electromagnetic field. Practical examples and experiments.

Optics: Microscope. Types of microscope, resolution, optical bench, optical prism and grid

Introduction to molecular modeling. Basic principles of molecular modeling, PDB database

Thermodynamics: Mass transfer. Diffusion. Osmosis. Nernst equation in biology, chemistry, physics, physiology

Exercises: Practical laboratory exercises: Statistical and computer data processing and the way of writing reports. Electrical cirrcuts, centrifuge, optical grid, optical bench, periodic voltage analyses, microscope, viscosity of the fluids, surface tension, air humidity, ultrasound, flow velocity calorimeter.

Mode of teaching

Lectures, Problem solving seminars, Laboratory exercises, individual tasks, multimedia and network, laboratory

Student obligations

Attendance of all forms of classes is mandatory, and the student must access all knowledge checks. The student can justifiably miss out on 30% of each of the forms of teaching. Undone exercise must be done subsequently.

Monitoring student work *(Connectivity of learning outcomes, teaching methods and grading)*

Teaching activity	ECTS	Learning outcome	Student activity	Assessment methods	Grade points	
					Min.	Max.
Attendance	0.5	1-4,6	Attendance	Evidence	0	0
Pracitical	1.0	5	Presence and active participation in exercises	Exercise log, knowledge check	0	10
Seminars	0.5	1-4,6	Solving default problems on your own, solving default tasks, short written checks	Essay, records of resolved tasks, short written checks	0	10
Written exam	2.0	1-6	Study	Written exam	0	40
Total	**5**				**0**	**60**

Calculation of final grade:
(1) practical exam – Students will do 6 practical exercises during class before each practical exercise, students take an entrance colloquium consisting of three questions (multiple choice, essay and computational task). Based on points from colloquium students:
- receive 1 point (all three correct answers),
- have the right to do the exercise (2/3 of the correct)
- must reimburse the training (0 or 1 correct)
(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 (2); 42-47 good (3); 48-53 very good (4); 54-60 excellent (5)
(4) an oral exam (if the student wishes he/she can register an oral exam instead of a written exam)

Required reading (available in the library and through other media)

Title	Number of copies in the library	Availability through other media
Jasminka Brnjas - Kraljević: Fizika za studente medicine, Medicinska naklada, Zagreb, 2001. ISBN: 9531761566.	30	
Brnjas-Kraljević: Fizika 1, Struktura tvari i dijagnostičke metode, Medicinska naklada, Zagreb, 2001.	10	
Priprema za praktične vježbe iz Medicinske fizike i biofizike		Yes

Additional reading

Franjo Šolić, Gordana Žauhar: FIZIKA ZA MEDICINARE, Sveučilište u Rijeci, Medicinski fakultet, Rijeka 2013.

Course evaluation procedures

Anonymous, quantitative, standardised student survey on the course and the teacher's work implemented by the Quality improvement office of the Faculty of Medicine Osijek.