MEDICAL PHYSICS AND BIOPHYSICS	
GENERAL INFORMATION	
Course coordinator	Professor Dario Faj, PhD
Assistant/Associate	Assistant Professor Hrvoje Brkić, PhD Assistant Profesor Mladen Kasabašić, PhD Ivana Krpan, MSc
Study Programme	Integrated undergraduate and graduate university study of Medicine
Status of the course	Mandatory
Year of study, semester	1st year, 1st semester
ECTS	**6**
Workload (hours)	Lectures (24); Seminars (20); Exercises (16)
Expected number of students	70
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)	
1. Interpret basic physical laws and apply them in biological systems 2. Interpret the physical basis of biological processes at the molecular level 3. Interpret the mechanisms of operation of biological systems based on knowledge of basic physical laws using simple models 4. Interpret the physical basics of diagnostic and therapeutic methods in medicine 5. Measure given physical sizes and interpret measurement results	
Course content	
Lectures *Basic mathematical functions in biology and medicine*: Linear. Reciprocal addiction. Exponential. Logarithmic. Periodic: harmonic and nonharmonious. Vectors and vector operations. Differential bill. *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). The interaction between electromagnetic radiation and matter. The law of absorption. Introduction to spectroscopy. Types of spectroscopy. Use of radioactivity and EM waves in medicine. *Optics:* Electromagnetic wave; breakage reflection, sagging, dispersion. Geometric optics. Spreading light through space. Diopters: straight, spherical and combinations of diopter. Lens. Mirrors. Physical optics. *The concept 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. Centripetar and centrifugal force, use in medicine, experiment. Leverage; 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's law. Rheological properties of blood. Simpler examples of the application of the basic laws of hydrostatics and hydrodynamics to the human body. *Introduction to electricity and magnetism:* Electric and magnetic field. Polarisation. Induction. Action potential. Physical bases ECG, EEG and EEG. Tissues in the electrical and magnetic fields. Tissue in a constant and variable electric field; mechanisms of tissue polarization. Tissue in a constant and variable magnetic field; magnetic properties of the substance. Tissue heating mechanisms in variable electrical, variable magnetic and electromagnetic fields. Practical examples and experiments. *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's equation in biology, chemistry, physics, physiology. *Flickering as the source of the wave:* Sound wave. Spreading a sound wave through space. Audiometria; isophon curves. Intensity level. Db. Volume level. The relationship between physical and physiological parameters. *Ultrasound:* Mode of operation and performance of the UZV device. Physical basics. The Doppler effect. Mode and performance of an UZV that uses the Doppler effect. Physical limitations of the UZV device.

Seminars

Computational tasks and practical examples (experiments): Radioactivity. Electromagnetic radiation. Types of electromagnetic radiation (experiment). Dual properties of EM light (experiment). Interaction of electromagnetic radiation and matter (experiment). The law of absorption (experiment). Introduction to spectroscopy (experiment). The use of radioactivity and EM waves in medicine. Eetromagnetic wave; breakage reflections, sagging, dispersion. Geometric optics. Diopters: straight, spherical and combinations of diopter. Lens. Mirrors. The motion of solid bodies. The energy of the body. Newton's laws. Centripetal and centrifugal force, use in medicine (experiment). Lever. Types of levers in the human body (experiment). Gas physics and an example of application in medicine (experiment). Basic laws of hydrostatics and hydrodynamics on the human body. Tissues in the electrical and magnetic field (experiment). Tissue in a permanent and variable electrical field (experiment). Thermodynamics of biological systems. Macromolecule modeling. A practical example of energy transfer due to different temperatures and numerical problem solving. Nernst's equation in biology, chemistry, physics, physiology. It's a sound wave. Audiometria; isophonic curves. The relationship between physical and physiological parameters. Mode and performance of the UZV device (experiment).

Performing practical laboratory exercises

Performing measurements of given physical sizes. Statistical and computer data processing and how reports are written. Interpretation of the results. Radioactivity. Types of electromagnetic radiation. The interaction between electromagnetic radiation and matter. The law of absorption. Introduction to spectroscopy. Types of spectroscopy. Electromagnetic wave; breakage reflections, sagging, dispersion. Geometric optics. Physical optics. Leverage; translational and rotational balance. Buoyancy, Bernoulli's Law, Poissel's Law. The basics of electromagnetism and electrical components. Tissues in the electrical and magnetic fields. Termodynamics of biological systems: air moisture and energy transfer. Flickering as the source of the wave: Sound wave. Determination of physical parameters of sound and the relationship between physical and physiological parameters. Ultrasound: determination of resolution and insight into artifacts by measurements on the UZV phantom. Physical limitations of the UZV device.

Mode of teaching

Lectures; Seminars; Laboratory exercises

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 *(alignment of learning outcomes, teaching methods and grading)*

Teaching activity	ECTS	Learning outcome	Student activity	Assessment methods	Grade points	
					Min.	Max.
Attendance	0,5	1-5	Attendance	Evidence	0	0
Pracitical	2	5	Presence and active participation in exercises	Exercise log, knowledge check	0	10
Seminars	1	1-4	Solving default problems on your own, solving default tasks, short written checks	Essay, records of resolved tasks, short written checks	0	10
Written exam	2,5	1-5	Study	Written exam	0	40
Total	**6**				**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.	40	
J. Brnjas-Kraljević: Fizika 1, Struktura tvari i dijagnostičke metode, Medicinska naklada, Zagreb, 2001.	10	
Literatura Katedre dana na web stranici Katedre		www.physics.mefos.hr; Merlin

Additional reading

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

Course evaluation procedures

Anonymous, quantitative, standardized student survey on the reception and work of teachers conducted by the Office for Quality of the Faculty of Medicine Osijek.

Note /Other

E-learning does not enter the norm of subject hours, but is used in teaching and contains links to different pages, video and audio materials available on websites.