Name of the course	**Medical physics and biophysics**				**Code**	
Type of study program Cycle	Integrated study program, medicine				**Year of study**	II
Credits (ECTS) :	**4,5**	*Semester*	III		Number of hours per semester (l+e+s)	60 (24+20+16)
Status of the course:	required	*Preconditions:*	passed all the exams of the first year	*Comparative conditions:*		
Access to course:	Second year students			*Hours of instructions*:		According to schedule
Course teacher:	Professor Dario Faj					
Consultations:	hour before and after lectures					
E-mail address and phone number:	dariofaj@mefos.hr					
Associate teachers	Stipe Galić, dipl. ing. Assistant professor Mladen Kasabašić dr. sc. Hrvoje Brkić					
Consultations:	hour before and after lectures					
E-mail address and phone number:	fizika@mefos.hr					
The aims of the course:	The aims of this course are: Understanding the basic concepts of physics and their application to biological systems. Applying knowledge and skills associated with force and motion, optics and optical devices, electricity and magnetism, the basics of spectroscopy, hydrodynamics and hydrostatics, electromagnetic spectrum, ionizing radiation sources, thermodynamics, oscillations, sound and ultrasound waves and their application in medicine and physiology. Synthesize the analytical, quantitative approach to the study of the functions of the human body.					
Learning outcomes (general and specific competences):	• Evaluation of physical basics necessary for understanding the application of physical laws in biological systems • Understanding the physical quantities and units used in biophysics and medical physics • Remembering and understanding the physical basis of biological processes at the molecular level • Understanding the mechanisms of biological systems based on knowledge of the fundamental laws of physics using simple models • Applying the ways of transfer of energy and materials within the					

	body and in its interaction with the environment • Understanding the impact of external sources of energy on the body • Evaluation of the physical basis of diagnostic and therapeutic methods in medicine • Applying the use of simpler measuring instruments and interpretation of the results • Applying the knowledge gained in the field of physics in practice and independently continue to expand their knowledge in the above areas.
Course content (Syllabus):	Course consists of 9 units, 2 test assessment in seminars, colloquium assessment on exercises, individual work on a given topic and solving numerical problems. Each thematic unit includes: 2-3 hours of lectures, 1 to 2 hours of seminars and 2-3 hours of exercises. **Basic mathematical functions in biology and medicine**: Linear. The reciprocal dependence. Exponential. Logarithmic. Periodic: harmonic and anharmonic. The vectors and vector operations. Differential calculus. **Performing practical laboratory exercises**: A statistical and computer processing of data and way of writing. **The structure of atoms and molecules:** Structure and stability of atomic nuclei. Radioactivity. The structure of the molecule. Covalent, ionic and polar binding. The energy situation in the molecule. Electromagnetic radiation. The types of electromagnetic radiation. The dual properties of EM light (test). The interaction of electromagnetic radiation and matter. Law absorption. Introduction to spectroscopy. The types of spectroscopy. The use of radioactivity and EM waves in medicine **Optics**: Electromagnetic waves; refraction reflection, diffraction, dispersion. Geometric optics. The spread of light through space. The sphere level, and a combination of spherical diopter. Lenses. Mirrors. Physical optics. **The concept of force and energy**: The movement of solid bodies. Energy of the body. Newton's laws. The movement and deformation of solids under the action of forces. Centripetal and centrifugal force, the use in the medicine, experiment. Lever; translational and rotational balance. Types lever in the human body. **Hydrostatics and hydrodynamics**: Physics of gases and example applications in medicine. Pressure. Pascal's law, hydrostatic pressure, buoyancy, Bernoulli's law, Poisselov law. The rheological properties of the blood. Simpler examples of the basic laws of hydrostatics and hydrodynamics of the human body.

<table>
<tr><td></td><td colspan="4">Introduction to Electricity and Magnetism: Electric and magnetic field. Polarization. Induction. The action potential. Physical basics of ECG, EEG and EEG. Tissues in electric and magnetic field. The tissue in constant and variable electric field; Mechanisms of tissue polarization. The tissue in constant and variable magnetic field; Magnetic properties of matter. Mechanisms of heating tissue in the changing electric, variable magnetic and electromagnetic field. Practical examples and experiments.

Thermodynamics: Basic laws of thermodynamics. Thermodynamics of biological systems. The transfer of energy. Practical example of energy transfer due to different temperature and numerical solution problems . Transfer of mass. Diffusion. Osmosis. Nernst equation in biology, chemistry, physics, physiology

Flickering as the source of the wave: The sound wave. Sound wave propagation through space. audiometry; isophonic curve. The level of intensity. dB. Volume level. The relationship of physical and physiological parameters

Ultrasound: Operation and performance of ultrasound devices. Physical basis. Doppler effect. Operation and implementation of ultrasound that uses the Doppler effect. Physical limitations of ultrasound devices</td></tr>
<tr><td rowspan="3">Format of instruction (mark in bold)</td><td>Lectures</td><td>Exercises</td><td>Seminars</td><td>Independent assignments</td></tr>
<tr><td>Consultations</td><td>Work with mentor</td><td>Field work</td><td>Other</td></tr>
<tr><td colspan="4">Remarks:</td></tr>
<tr><td>Student responsibilities</td><td colspan="4">Attendance at all forms of instruction is required, and the student should access to all the knowledge tests. Student may legitimately be absent from 30% of lectures and seminars. If student miss practical exercise it must be compensate.</td></tr>
<tr><td rowspan="3">Screening student work (mark in bold)</td><td>Class attendance</td><td>Class participations</td><td>Seminar essay</td><td>Practical training</td></tr>
<tr><td>Oral exam</td><td>Written exam</td><td>Continous assesment</td><td>Essay</td></tr>
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Detailed evaluation within a *European system of points*

STUDENTS RESPONSIBILITIES	HOURS	PROPORTIONS OF ECTS CREDITS	PROPORTIONS OF MARK
Class attendance and participations	40	1.5	
Seminar essay	10	0.5	6%
Written exam	30	1	80%
Continous assesment	15	0.5	10%
Practical work	25	1	4%

Further clarification:

Attendance: Attendance at more than 70% of lectures and seminars, and do of all laboratory exercises.
Practical work (exercise): attendance at all laboratory exercises, and taking the practical part of the exam. The practical part of the exam is required to pass. Passed exam means duly completed laboratory testing exercise without major errors and comprehension exercises performance (2%), or exercise performed without error and understanding exercises performance (4%). Once passed the practical exam value by the end of the academic year.
Seminars: seminar paper on a given topic and presentation to other students:
0% = The work is not written or plagiarism.
0% = The work does not meet the formal criteria or the content is incorrect or out of the default theme.
1% = The work meet the formal criteria but are perceived more deficiencies in the content field.
2% = Work satisfies both form and content and were observed grammatical and spelling errors.
3% = The work is exhaustive, substantially affected by the grammar and spelling is correct.
Presentation:
0% = work is not presented
1% = work is presented with errors in pronunciation and grammar and poor cooperation with listeners
2% = work is solidly presented, occasional errors in pronunciation or grammar with the existing cooperation with listeners
3% = work is exquisitely presented, almost without language errors, excellent cooperation and relationship with the audience
Final written exam
Exam with 40 questions with multiple answers. Each correct answer carries 2% of the total marks.

Continuous assessment and a short written test
b) Participation in solving numerical problems - a maximum of 2% of the grade
c) Written and oral assessment during class - up to 8% of the grade

Final score:
The final assessment is carried out according to the Regulation of Studies of the University of

Mostar and applies to all study groups. According to the Regulations on studying final grade is obtained as follows: A = 91-100% 5 B = 79 to 90% 4 C = 67 to 78% 3 D = 55 to 66% 2 F = 0 to 54% 1	
Required literature:	JasminkaBrnjas - Kraljević: Physics for medical students, Medicinska naklada, Zagreb, 2001. ISBN: 9531761566. J. Brnjas-Kraljević: Physics 1, the structure of substances and diagnostic methods, Medicinskanaklada, Zagreb, 2001. Literature : www.physics.mefos.hr
Optional literature:	FranjoŠolić, GordanaŽauhar: Physics for medical students, Sveučilište u Rijeci, Medicinski fakultet, Rijeka 2013. D. C. Giancoli: Physics: Principles with Applications, Sixth Edition, Prentice Hall, Inc., 2004. ISBN: 0130606200. G. Rontó, I. Tarján, L. Berkes, S. Györgyi: An Introduction to Biophysics with Medical Orientation, AkadémiaiKiadó, Budapest, 1999. ISBN: 9630576074
Additional information about the course	

Annexes: calendar classes

The number of teaching units	**TOPICS AND LITERATURE**
I.	Title: Introduction
	Short description: Overview of the college. Division of seminars and manner of performance. The initial test. Basic mathematical functions, vectors, Fourier analysis, integral, differential. Basic physical quantities and units. Body motion (kinematics).
	Literature: required and optional
II.	Title: The structure of atoms and molecules
	Short description: Structure and stability of atomic nuclei. Radioactivity. The structure of the molecule. Covalent, ionic and polar binding. The energy situation in molekuli.Electromagnetic radiation. The types of electromagnetic radiation. The dual properties of EM light (test CD as an optical grating). The interaction of electromagnetic radiation and matter. Law absorption (experiment). Introduction spectroscopy. The types of spectroscopy. The use of radioactivity and EM waves in medicine.
	Literature: required and optional

III.	Title: Hydrostatics and hydrodynamics
	Short description: Pressure. Physics of gases and example applications in medicine. Pascal's law, hydrostatic pressure, buoyancy. Bernoulli's law. Properties of real fluid. Poisselov law. Surface tension liquids. The rheological properties of the blood. Simpler examples of the basic laws of hydrostatics and hydrodynamics of the human body.
	Literature: required and optional
IV.	Title: The concept of force and energy
	Short description: The movement of solid bodies. Energy body. Newton's laws. Examples (motion, centrifugal force, ...). The movement and deformation of solids under the action of forces. Lever; translational and rotational balance. Types lever in the human body. Deformation of solids. Modeling of biological materials.
	Literature: required and optional
V.	Title: Thermodynamics
	Short description: thermodynamics laws. Calorimeter. Thermodynamics of biological systems. The transfer of energy. Diffusion. Thermodynamics of biological systems. The transfer of energy. Mass transfer.
	Literature: required and optional
VI.	Title: flicker as the source wave. sound wave
	Short description: Sound wave propagation through space. audiometry; izophonic curve. The level of intensity. dB. Volume level. The relationship of physical and physiological parameters. Ultrasound. Operation and implementation of ultrasound devices. Physical basis. Doppler effect. Operation and implementation of ultrasound that uses the Doppler effect. Physical limitations of ultrasound devices.
	Literature: required and optional
VII.	Title: Electricity and magnetism
	Short description: Introduction to Electricity and Magnetism. Electric and magnetic field. Polarization. Induction. The action potential. Physical basics of ECG, EEG and EEG.
	Literature: required and optional
VIII.	Title: Optics
	Short decription: The electromagnetic waves; refraction reflection, diffraction, dispersion. Geometric optics. The spread of light through space. The sphere level, and a combination of spherical diopter. Lenses. Mirrors.
	Literature: required and optional