

Plan of the course

Physics 1 - Basic Physics with Biophysics Essays

Academic year **2016/2017**

doc. dr. sc. Maja Balarin

I. COURSE AIMS

The Physics I is an introductory course which provides students with an insight into the physical principles that are needed for the better understanding of processes in anatomy, biochemistry, physiology, histology, pathology and others.

The course is built up on the premise about the knowledge of the basic physical laws adopted during the previous schooling. During the course students will acquire the knowledge about the physical mechanisms and phenomena in biological systems, as well as how to apply the basic physical principles and methods in the qualitative, quantitative and functional analysis, both on the macroscopic and molecular level.

The topics will include the transport of energy and mass in biological systems and the influence of external energy sources on systems, as well as, the basic mechanical, electromagnetic, optical and acoustic properties of a human body. The students will acquire the ability to explain how body works as a thermodynamic system, to apply the energy conservation law in the calculation of energy equilibrium of a body, to explain the physical phenomena on which the cellular transport mechanisms are based, and to understand how we walk, talk, see and hear.

In the laboratory work the students will adopt the ability and skills in using the measuring devices which they might find integrated in different medical devices. After this course the students will be able to collect data and critically evaluate and interpret the results, as well as, use the International System of Units and Measurements in medicine correctly.

II. COURSE STRUCTURE

Course hours:

Lectures: 20

Seminar: 16

Practicum: 24

Total hours: 60

Students are divided in 2 seminar groups and 2 laboratory groups: A, B

The attendance of all lectures, seminars and labs is obligatory. If necessary, a student can be absent from classes up to 20% of the overall course load but have to make up for seminars and lab work.

Missed seminars have to be submitted in a form of essay to the course coordinator **no later than December, 9th 2016**.

Missed labs have to be made up during the semester with some other group or during the **make-up lab hours on December, 6th 2016 from 8.00 – 10.00 AM**. During each make-up lab only one missed exercise can be completed.

The completion and proper documentation of each lab exercise and seminar and thereafter the approval by the course instructor are necessary for the course completion and for obtaining the signature in the Index. Indexes for the **signature** will be collected on **December 8th and 9th 2016 during the preliminary practical exam**. A student has to get the signature in Index prior taking the exam.

III. PLAN OF THE COURSE AND COURSE SCHEDULE

BLOCKS OF THE COURSE

Number of blocks: 1

Block number	Start	End
1.	4.10.2016	16.12.2016

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Number of blocks: 1

Block number	Start	End
1.	4.10.2016	16.12.2016

BLOCKS OF THE COURSE SCHEME

Block 1

Date	Time	Group	Course hours type	Theme	Teaching staff
Wednesday 5.10.2016.	08:00-09:30; MEF Wickerhauser	A,B	Practicum	Introduction, vector operations	doc. dr. sc. Maja Balarin, doc. dr. sc. Sanja Dolanski-Babić, dr. sc. Marin Kosović
Thursday 6.10.2016.	08:30-10:00; MEF Wickerhauser	A,B	Lectures	Matter and energy, fundamental forces; force field	doc. dr. sc. Ozren Gamulin
Friday 7.10.2016.	08:30-10:00; MEF Wickerhauser	A,B	Lectures	Structure of atom and molecule; molecular bonds; energy states	doc. dr. sc. Maja Balarin
Tuesday 11.10.2016.	08:00-10:00; MEF Fizika Praktikum	A	Practicum	Basic mathematics	dr. sc. Marin Kosović, dr. sc. Kristina Serec, doc. dr. sc. Sanja Dolanski-Babić
	08:15-09:45; MEF Wickerhauser	B	Seminar	Implementation of the Newton laws; levers in body, passive walking and high jump	doc. dr. sc. Ozren Gamulin
Wednesday 12.10.2016.	08:00-10:00; MEF Fizika Praktikum	B	Practicum	Basic mathematics	dr. sc. Marin Kosović, Marko Škrabić, ???, doc. dr. sc. Ozren Gamulin
	08:15-09:45; MEF Wickerhauser	A	Seminar	Implementation of the Newton laws; levers in body, passive walking and high jump	doc. dr. sc. Maja Balarin
Thursday 13.10.2016.	08:00-10:00; MEF Fizika Praktikum	A	Practicum	Exercises 1 – 7	dr. sc. Marin Kosović, doc. dr. sc. Sanja Dolanski-Babić, dr. sc. Kristina Serec
	08:15-09:45; MEF Wickerhauser	B	Seminar	Fluids; hydrostatics, surface tension and its implications, alveolar surfactant	doc. dr. sc. Ozren Gamulin
Friday 14.10.2016.	08:00-10:00; MEF Fizika Praktikum	B	Practicum	Exercises 1 – 7	dr. sc. Kristina Serec, dr. sc. Marin Kosović, doc. dr. sc. Maja Balarin
	08:15-09:45; MEF Wickerhauser	A	Seminar	Fluids; hydrostatics, surface tension and its implications, alveolar surfactant	doc. dr. sc. Ozren Gamulin
Tuesday 18.10.2016.	08:30-10:00; MEF Wickerhauser	A,B	Lectures	Elasticity; viscoelastic properties of body tissues – mechanical models Hydrodynamics, ideal and real fluids	doc. dr. sc. Ozren Gamulin
Wednesday 19.10.2016.	08:00-10:00; MEF Fizika Praktikum	B	Practicum	Exercises 1 – 7	dr. sc. Marin Kosović, dr. sc. Kristina Serec, Marko Škrabić, ???

Date	Time	Group	Course hours type	Theme	Teaching staff
	08:15-09:45; MEF Wickerhauser	A	Seminar	Rheology of blood flow	doc. dr. sc. Sanja Dolanski-Babić
Thursday 20.10.2016.	08:00-10:00; MEF Fizika Praktikum	A	Practicum	Exercises 1 – 7	Marko Škrabić, ???, dr. sc. Kristina Serec, doc. dr. sc. Ozren Gamulin
	08:15-09:45; MEF Wickerhauser	B	Seminar	Rheology of blood flow	doc. dr. sc. Sanja Dolanski-Babić
Tuesday 25.10.2016.	08:30-09:30; MEF Biološka	A,B	Exam	Quiz 1	doc. dr. sc. Maja Balarin, doc. dr. sc. Ozren Gamulin, doc. dr. sc. Sanja Dolanski-Babić, dr. sc. Marin Kosović, dr. sc. Kristina Serec, Marko Škrabić, ???
Wednesday 26.10.2016.	08:00-10:00; MEF Fizika Praktikum	B	Practicum	Exercises 1 – 7	doc. dr. sc. Maja Balarin, Marko Škrabić, ???, dr. sc. Kristina Serec
	08:15-09:45; MEF Wickerhauser	A	Seminar	Basic principles of thermodynamics; I and II law	doc. dr. sc. Sanja Dolanski-Babić
Thursday 27.10.2016.	08:00-10:00; MEF Fizika Praktikum	A	Practicum	Exercises 1 – 7	Marko Škrabić, ???, dr. sc. Kristina Serec, doc. dr. sc. Maja Balarin
	08:15-09:45; MEF Wickerhauser	B	Seminar	Basic principles of thermodynamics; I and II law	dr. sc. Marin Kosović
Friday 28.10.2016.	08:30-10:00; MEF Wickerhauser	A,B	Lectures	Thermodynamics of the biological system; transfer of heat	doc. dr. sc. Sanja Dolanski-Babić
Wednesday 2.11.2016.	08:45-09:45; MEF Wickerhauser	A,B	Lectures	Gibbs's energy and chemical potential; transfer of particles and ions through membranes	doc. dr. sc. Sanja Dolanski-Babić
Thursday 3.11.2016.	08:00-10:00; MEF Fizika Praktikum	B	Practicum	Exercises 1 – 7	dr. sc. Kristina Serec, dr. sc. Marin Kosović, Marko Škrabić, ???
	08:15-09:45; MEF Wickerhauser	A	Seminar	Sources and properties of electric and magnetic fields; electric dipole in external electric field; microwave therapy	doc. dr. sc. Maja Balarin
Friday 4.11.2016.	08:00-10:00; MEF Fizika Praktikum	A	Practicum	Exercises 1 – 7	Marko Škrabić, ???, dr. sc. Marin Kosović, doc. dr. sc. Maja Balarin
	08:15-09:45; MEF Wickerhauser	B	Seminar	Sources and properties of electric and magnetic fields; electric dipole in external electric field; microwave therapy	doc. dr. sc. Sanja Dolanski-Babić
Tuesday 8.11.2016.	08:00-10:00; MEF Fizika Praktikum	A	Practicum	Exercises 1 – 7	Marko Škrabić, ???, doc. dr. sc. Sanja Dolanski-Babić, dr. sc. Kristina Serec
Wednesday 9.11.2016.	08:00-10:00; MEF Fizika Praktikum	B	Practicum	Exercises 1 – 7	dr. sc. Kristina Serec, Marko Škrabić, ???, dr. sc. Marin Kosović
Thursday 10.11.2016.	08:30-10:00; MEF Wickerhauser	A,B	Lectures	Polarization of tissue in steady and alternating electric field	doc. dr. sc. Ozren Gamulin

Date	Time	Group	Course hours type	Theme	Teaching staff
Friday 11.11.2016.	08:30-10:00; MEF Wickerhauser	A,B	Lectures	Matter in external magnetic field; biological system in electrical circuit, rheography; magnetotherapy	doc. dr. sc. Ozren Gamulin
Tuesday 15.11.2016.	08:00-10:00; MEF Fizika Praktikum	A	Practicum	Exercises 1 – 7	Marko Škrabić, ???, dr. sc. Kristina Serec, doc. dr. sc. Ozren Gamulin
Wednesday 16.11.2016.	08:00-10:00; MEF Fizika Praktikum	B	Practicum	Exercises 1 – 7	Marko Škrabić, ???, doc. dr. sc. Ozren Gamulin, dr. sc. Marin Kosović
Thursday 17.11.2016.	08:30-09:30; MEF Biološka	A,B	Exam	Quiz 2	doc. dr. sc. Maja Balarin, doc. dr. sc. Ozren Gamulin, doc. dr. sc. Sanja Dolanski-Babić, dr. sc. Marin Kosović, dr. sc. Kristina Serec, Marko Škrabić, ???
Friday 18.11.2016.	08:30-10:00; MEF Wickerhauser	A,B	Lectures	Electric and magnetic fields in human body – application in diagnostics	doc. dr. sc. Sanja Dolanski-Babić
Tuesday 22.11.2016.	08:00-10:00; MEF Fizika Praktikum	B	Practicum	Exercises 1 – 7	doc. dr. sc. Maja Balarin, doc. dr. sc. Sanja Dolanski- Babić, Marko Škrabić, ???
	08:15-09:45; MEF Wickerhauser	A	Seminar	Laws of refraction and reflection; image formation by plane and spherical surfaces of refraction thick and thin lenses, lens aberations	dr. sc. Marin Kosović
Wednesday 23.11.2016.	08:15-09:45; MEF Wickerhauser	B	Seminar	Laws of refraction and reflection; image formation by plane and spherical surfaces of refraction thick and thin lenses, lens aberations	doc. dr. sc. Maja Balarin
Thursday 24.11.2016.	08:00-10:00; MEF Fizika Praktikum	A	Practicum	Exercises 1 – 7	dr. sc. Marin Kosović, doc. dr. sc. Ozren Gamulin, doc. dr. sc. Sanja Dolanski-Babić
	08:15-09:45; MEF Wickerhauser	B	Seminar	Optics of the eye	doc. dr. sc. Maja Balarin
Tuesday 29.11.2016.	08:15-09:45; MEF Wickerhauser	A	Seminar	Optics of the eye	doc. dr. sc. Ozren Gamulin
Wednesday 30.11.2016.	08:30-10:00; MEF Wickerhauser	A,B	Lectures	Image formation by magnifying glass and microscope; resolution of microscope	doc. dr. sc. Maja Balarin
	10:00-10:45; MEF Wickerhauser	A,B	Lectures	Types of optical microscopes; electronic transmission and scanning microscope	doc. dr. sc. Maja Balarin
Thursday 1.12.2016.	08:30-10:00; MEF (C) - Šercer	A,B	Lectures	Oscillations and sound wave; wave equation, intensity and intensity level	doc. dr. sc. Ozren Gamulin
Friday 2.12.2016.	08:00-09:30; MEF Wickerhauser	A	Seminar	Connection between physical and physiological parameters of sound	doc. dr. sc. Maja Balarin
	09:45-11:15; MEF Wickerhauser	B	Seminar	Connection between physical and physiological parameters of sound	doc. dr. sc. Maja Balarin

Date	Time	Group	Course hours type	Theme	Teaching staff
Tuesday 6.12.2016.	08:00-10:00; MEF Fizika Praktikum	A,B	Practicum	LAB MAKE-UP	Marko Škrabić, ???, dr. sc. Marin Kosović, dr. sc. Kristina Serec, doc. dr. sc. Ozren Gamulin, doc. dr. sc. Sanja Dolanski- Babić
Wednesday 7.12.2016.	08:30-09:30; MEF Biološka	A,B	Exam	Quiz 3	doc. dr. sc. Maja Balarin, Marko Škrabić, ???, dr. sc. Kristina Serec, dr. sc. Marin Kosović, doc. dr. sc. Sanja Dolanski-Babić
Thursday 8.12.2016.	08:00-09:00; MEF Fizika Praktikum	A	Exam	Preliminary practical exam	Marko Škrabić, ???, dr. sc. Kristina Serec, dr. sc. Marin Kosović, doc. dr. sc. Maja Balarin, doc. dr. sc. Sanja Dolanski-Babić
Friday 9.12.2016.	08:00-09:00; MEF Fizika Praktikum	B	Exam	Preliminary practical exam	Marko Škrabić, ???, dr. sc. Kristina Serec, dr. sc. Marin Kosović, doc. dr. sc. Ozren Gamulin, doc. dr. sc. Sanja Dolanski-Babić
Monday 19.12.2016.	08:00-09:00; MEF Nova vijećnica	A,B	Exam	EXAM	doc. dr. sc. Maja Balarin, doc. dr. sc. Sanja Dolanski- Babić, dr. sc. Marin Kosović, dr. sc. Kristina Serec, Marko Škrabić, ???
Thursday 19.1.2017.	08:30-09:30; MEF Nova vijećnica	A,B	Exam	EXAM	doc. dr. sc. Sanja Dolanski-Babić, doc. dr. sc. Ozren Gamulin, dr. sc. Marin Kosović, dr. sc. Kristina Serec, Marko Škrabić, ???, doc. dr. sc. Maja Balarin
Tuesday 4.7.2017.	08:30-09:30; MEF Nova vijećnica	A,B	Exam	EXAM	doc. dr. sc. Sanja Dolanski-Babić, doc. dr. sc. Ozren Gamulin, dr. sc. Marin Kosović, dr. sc. Kristina Serec, Marko Škrabić, ???, doc. dr. sc. Maja Balarin
Tuesday 29.8.2017.	08:30-09:30; MEF Nova vijećnica	A,B	Exam	EXAM	doc. dr. sc. Sanja Dolanski-Babić, doc. dr. sc. Ozren Gamulin, dr. sc. Marin Kosović, dr. sc. Kristina Serec, Marko Škrabić, ???, doc. dr. sc. Maja Balarin

Date	Time	Group	Course hours type	Theme	Teaching staff
Monday 11.9.2017.	08:30-09:30; MEF Nova vijećnica	A,B	Exam	EXAM	doc. dr. sc. Sanja Dolanski-Babić, doc. dr. sc. Ozren Gamulin, dr. sc. Marin Kosović, dr. sc. Kristina Serec, Marko Škrabić, ???, doc. dr. sc. Maja Balarin

Lab exercises:

Place: Department of Physics and Biophysics, Šalata 3, 2nd floor, right hallway

Textbook: Physics Laboratory Manual, Ed. M. Balarin, J. Brnjac-Kraljević, O. Gamulin, Medicinska naklada Zagreb

Exercise no.	Topics	Page
a	Introduction; vector operations	
b	Basic mathematics, Analysis of experimental data	1-4
1	Electric circuits (exercises 1-5)	5-13
2	Microscope (exercises 1-2)	39-43
3	Specific heat (exercise 1)	65-69
	Flow of fluids (exercise 1)	57-58
4	Electromotive force (exercise 1)	15-18
	Electric conductivity of electrolytes (exercise 1)	19-22
5	Lenses (exercises 1-3)	29-37
6	Deformation of rigid body (exercise 1)	49-52
	Viscosity of fluid (exercise 1)	53-56

7	Index of refraction (exercises 1-3)	23-28
	Diffraction grating (exercises 1-2)	45-48

At each lab work term (from 1 to 7) students have to solve short computer test with questions connected to the exercise they are doing at that term. To be able to do so students have to prepare for the lab at home. The results of the lab tests will be announced at the end of the course when the lab tests grade will be generated. This grade is **20%** of the final exam grade.

IV. EXAMINATIONS

The exam has three parts: written, practical and oral.

Throughout the course, students are offered three partial tests (quizzes) consisting of **12** questions each. Student must have **6** correct answers to pass the quiz.

If the cumulative score, from all three passed quizzes is at least **20** the student is exempted from the written part of the exam.

Quiz 1 covers the topics presented in Lectures 1-3, seminars 1-3 and Lab a and b is scheduled on **October 25th 2016**.

Quiz 2 covers the topics presented in Lectures 4-7 and seminars 4-5 is scheduled on **November 17th 2016**.

Quiz 3 covers the topics presented in Lectures 8-11 and seminars 6-8 is scheduled on **December 7th 2016**.

If a student has not collected 20 points throughout the semester, then he has to take a written exam prior to oral exam. Written exam comprises of **36** questions and to pass it the student must have **22** correct answers. To take an oral exam a student has to pass the written part. If a student has failed the written part for the third time, he/she is allowed to take the oral part anyway.

Immediately after finishing all lab exercises, students are offered to take preliminary practical exam. If a student fails in this exam, he or she is obliged to take practical part of the exam at regular exam terms.

Preliminary practical exam: December 8th and 9th 2016.

Once the written and practical parts of the exam are passed they remain valid for all exam terms in that academic year.

To get a grade of the course a student has to pass **all three parts of the exam**.

Final grade = 0.2*lab tests grade + 0.8*oral and written exam grade

Regular terms	Exam date	Application due	Cancelation due
		23:59 hours	12:00 hours
Winter	19. 12. 2016	14. 12. 2016	16. 12. 2016
	19. 01. 2017	15. 01. 2017	17. 01. 2017
Summer	04. 07. 2017	30. 06. 2017	02. 07. 2017
Autumn	29. 08. 2017	25. 08. 2017	27. 08. 2017
	11. 09. 2016	07. 09. 2017	09. 09. 2017

V./I. LIST OF LECTURERS AND TEACHING STAFF

1. doc. dr. sc. Maja Balarin
2. doc. dr. sc. Ozren Gamulin
3. doc. dr. sc. Sanja Dolanski-Babić
4. dr. sc. Kristina Serec
5. Marko Škrabić, ???

V./II EXTERNAL ASSOCIATES:

1. dr. sc. Marin Kosović

V./III UNTENURED LECTURERS:

VI. LITERATURE

A. Obligatory

Textbook

The digital version of the course textbook is placed on LMS

Power point presentations of all lectures and seminars are placed on LMS.

B. Additional

1. I.P. Herman: Physics of the Human Body, Springer, Berlin, 2007
2. P. Davidovits P: Physics in Biology and Medicine, Harcourt Academic Press, San Diego, 2001.
3. A. Giambattista, B. McCarthy Richardson, R.C. Richardson: College Physics, McGraw Hill, Boston, 2007.
4. J.D. Cutnell, K.W. Johnson: Physics, John Wiley and Sons, New York, 1998.
5. D. Halliday, R. Resnick, J. Walker: Fundamental of Physics, John Wiley and Sons, New York, 2003.
6. J. R. Cameron, J. G. Skofronick, R.M. Grant: Physics of the Body, Medical Physics Publishing, Madison, 1992.