University of Zagreb School of Dental Medicine

Plan of the course

PHYSICS

Academic year 2017/2018

Course coordinator:
Assistant Professor Sanja Dolanski Babić, PhD

I. COURSE AIMS

The goal of physics course for student of dental medicine is to learn how to use basic physical principles and laws to describe biological processes and structure of biological systems at the molecular level. In studying metabolic processes and the interaction of the body with the environment simple physical models are used. Those models are based on knowledge of energy and matter transfer inside biological systems and action of external energy sources on biological systems. The main teaching task is to familiarize students with the knowledge of selected parts of physics connected with biological systems and, with examples in seminar classes, bring them closer to ways of thinking necessary to apply that knowledge in dentistry. In addition, students should be able to explain the physical basis of diagnostic and therapeutic methods in dentistry practice necessary for understanding them. Laboratory exercise have task to qualify students to do measurements, explain and present results of experiments. They also have a goal to qualify students for handling simple measuring devices and improve their understanding of basic physical laws.

II. COURSE STRUCTURE

Formal lectures	20 hours
Seminars	20 hours
Lab work	20 hours
Total hours:	**60**

All lectures, seminars and labs are obligatory.
A student can be absent from class 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 the form of essay to the course coordinator before the exam.
Missed labs have to be made up during the make-up lab hours provided by the Department. During the make-up lab, only one missed exercise can be completed.
The completion and proper documentation of each lab exercise and seminar and approval thereof by the course instructor are conditions for the course completion and obtaining the signature in the Index. A student has to get the signature prior taking the exam.

III. PLAN OF THE COURSE AND COURSE SCHEDULE

1. Week				
	Time	Type	Topic	Lecturer
Monday 16.04.2018.	**10:00 -11:30**	Lecture 1	The structure of matter: force and energy, vector and scalar fields, fundamental forces in nature; basic mathematical functions, periodic functions, Fourier theorem	S. Dolanski Babić, PhD
	12:00- 14:00	Lab A	Error calculation; graph drawing	M. Škrabić N. Šegedin
Tuesday 17.04.2018	**9:00 -10:30**	Seminar 1	Basic mechanics: Newton's laws, torque, conditions of translational and rotational equilibrium; lever, levers in the body, application in dentistry	S. Dolanski Babić, PhD
	10:45- 11:30	Lecture 2	The structure of atom energy states of atoms, electron quantum numbers, Paulli's exclusion principle	S. Dolanski Babić, PhD
Wednesday 18.04.2018	**9:00 -11:00**	Lab. 1	Exercises 1 – 6	M. Škrabić N. Šegedin
	12:30- 14:00	Lecture 3	Structure of molecule; molecular bonds; energy states; spectroscopy	S. Dolanski Babić, PhD
Thursday 19.04.2018.	**9:00-9:45**	Lecture 4	Oscillations: free, damped and forced - resonance	S. Dolanski Babić, PhD
	10:15-11:45	Seminar 2	Sound waves; physical and physiological parameters of sound, Doppler effect, ultrasound generator	S. Dolanski Babić, PhD
	12:45-14:45	Lab. 2	Exercises 1 – 6	M. Škrabić N. Šegedin
Friday 20.04.2018.	**8:30-9:15**	Lecture 5	Structure of solids: crystals and polycrystals; imperfections and defects in crystal lattice: point and line defects; metal alloys, polymers	O. Gamulin, PhD
	9:30-11:00	Lecture 6	Elastic force; linear elastic deformation; viscoelastic properties of matter; mechanical elements and models; mechanical properties of polymers; deformation in polymers	O. Gamulin, PhD

2. Week				
	Time	Type	Topic	Lecturer[4]
Monday 23.04.2018.	**11:00–12:30**	Seminar 3	Basics of hydrostatic: pressure in fluids, buoyancy, surface properties of fluid; adhesion in dentistry; model of ideal liquid	O. Gamulin, PhD
	13:00- 13:45	Lecture 7	Model of real fluid, Newton's law and Poiseuille's law; rheological properties of fluid	S. Dolanski Babić, PhD
Tuesday 24.04.2018.	**9:00 – 10:30** .	Seminar 4	Basic concepts of thermodynamics, I and II laws; mechanical and thermal interactions; Gibbs's energy and chemical potential	O. Gamulin, PhD
	11:00- 11:45	Lecture 8	Heat transfer: conduction, convection, evaporation and radiation	O. Gamulin, PhD
Wednesday 25.04.2018.	**9:00 – 10:30** .	Seminar 5	Transport of particles: free diffusion in fluids; 1st Fick's law; osmosis; transport of ions through a semi-permeable and permeable membrane; diffusion in solid body	O.Gamulin, PhD
	11:00- 13:00	Lab. 3	Exercises 1 – 6	M. Škrabić N. Šegedin
Thursday 26.04.2018.	**10:00- 12:00**	Lab. 4	Exercises 1 – 6	M. Škrabić N. Šegedin
Friday 27.04.2018.	**9:00**		**Quiz1**	M. Škrabić N. Šegedin
	11:00- 13:00 .	Lab. 5	Exercises 1 – 6	M. Škrabić N. Šegedin

3. Week				
	Time	Type	Topic	Lecturer[4]
Monday 30.04.2018.	**9:00 – 10:30**	Seminar 6	Sources and properties of electric and magnetic fields; Gauss's law; Maxwell theory	S. Dolanski Babić, PhD
	11:00- 11:45	Lecture 9	Polarization mechanisms of matter in electric field	S. Dolanski Babić, PhD
	12:00- 12:45	Lecture 10	Contact voltage; thermocouple, galvanic cell, galvanic corrosion and mouth galvanic phenomena	S. Dolanski Babić, PhD
Wednesday 02.05.2018.	**9:00 – 9:45**	Lecture 11	Matter in external magnetic field: paramagnetism, diamagnetism and ferromagnetism	S. Dolanski Babić, PhD
	10:00- 11:30	Seminar 7	Electric and magnetic fields in human body – application in diagnostics	O.Gamulin, PhD
	12:00- 14:00	Lab. 6	Exercises 1 – 6	M. Škrabić N. Šegedin
Thursday 03.05.2018.	**9:00 – 10:30**	Seminar 8	Basic of geometrical optics; thick lenses – image formation using principal planes; thin lenses - image formation; lens equation; chromatic and spherical aberrations; basic of wave optics: single-slit diffraction, diffraction gratings	O.Gamulin, PhD
	11:00- 12:30	Lecture 12	Optics of an eye; image formation by magnifying glass and optical microscope; Rayleigh theory of resolution; metallographic microscope, electron microscope	O.Gamulin, PhD
	13:00- 15:00	Lab	LAB MAKE-UP	M. Škrabić N. Šegedin
Friday 04.05.2018.	**9:00 – 9:45**	Lecture 13	Basic principles of lasers, laser applications in dentistry	O.Gamulin, PhD
	10:00- 10:45	Lecture 14	Interactions of electromagnetic waves with tissue	S. Dolanski Babić, PhD
	11:00-12:30	Lecture 15	X-ray tube; X-ray spectrum; effects of anode voltage and heating	S. Dolanski Babić, PhD

			current; interaction of X-radiation with tissue; contrast; half thickness of absorber; CT method	

4. Week				
	Time	Type	Topic	Lecturer[4]
Monday 07.05.2018.	**10:00** **12:00-13:30**	 Seminar 9	**Preliminary practical exam** Radioactive decays; radiation protection; dosimetry	M. Škrabić N. Šegedin S. Dolanski Babić, PhD
Tuesday 08.05.2018.	**9:00-10:30**	Seminar 10	NMR: Magnetic properties of nuclei, the interaction of magnetic moment with constant external magnetic field; resonance; magnetization and chemical shift	O. Gamulin, PhD
Wednesday 09.05.2018.	**10:00**		**Quiz 2**	M. Škrabić N. Šegedin
Friday 11.05.2018.			**EXAM**	

Lectures and seminars:
Textbook: The digital version of the course textbook, power point presentations of all lectures and seminars are placed on the web site: https://www.sfzg.unizg.hr/predmet/173111.
Additional literature:

1. J. Newman: Physics of the Life Sciences, Springer, New York 2008
2. I.P. Herman: Physics of the Human Body, Springer, Berlin 2007
3. P. Davidovits: Physics in Biology and Medicine, Harcourt Academic Press, San Diego, 2001.

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

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

Exercise no.	Topics	Page
A	Introduction; Analysis of experimental data	1-4
1	Viscosity of fluid (exercise 1) Deformation of rigid body (exercise 1)	53-56 49-52
2	Microscope (exercises 1,2)	39-43
3	Electric circuits (exercises 1-4)	5-11
4	Measurements of gamma source energies by Geiger-Muller counter Electric conductivity of electrolytes (exercise 1)	Additional paper 19-22
5	Analysis of optical emission spectra of gasses	Additional paper
6	Lenses (exercises 1,3)	29-37

IV. EXAMINATIONS

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

Throughout the course, students are offered two partial tests (quizzes) consisting of **18** questions each. Student must have **10** correct answers to pass the quiz.

If a student has not collected **20** points throughout the course, then he has to take a written exam prior to oral exam. Written exam has **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.

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.

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.

Regular terms	**Date**
Spring	11.05.2018.
Summer	
Autumn	

V. LIST OF LECTURERS AND TEACHING STAFF

Ozren Gamulin, PhD, Assistant Professor, Department Head
Sanja Dolanski Babić, PhD, Assistant Professor, Course coordinator
Marko Škrabić, Assistant
Nikola Šegedin, Assistant

VI. LIST OF EXAMINERS

Ozren Gamulin, PhD, Assistant Professor
Sanja Dolanski Babić, PhD, Assistant Professor