Biophysics

1. IMPRINT

Academic Year	2023/2024
Department	Faculty of Medicine and Dentistry
Field of study / Subject	English Dentistry Division
Main scientific discipline	Medical sciences
Study Profile	General academic
Level of studies	Uniform MSc
Form of studies	Full-time program
Type of module / course	Obligatory
Form of verification of learning outcomes	Completion
Educational Unit / Educational Units	Department of Experimental Physiology and Pathophysiology (1S7) Pawińskiego 3C, 02-106 Warszawa phon. 22 57 20 734; e-mail: 1s7@wum.edu.pl
Head of Educational Unit / Heads of Educational Units	Professor Marcin Ufnal, MD, PhD

Course coordinator	Professor Marcin Ufnal, MD, PhD phon. 22 57 20 734 mufnal@wum.edu.pl
Person responsible for syllabus	Marek Konop, MSc, PhD phon. (22) 57 20 734, e-mail: marek.konop@wum.edu.pl
Teachers	Marcin Ufnal, MD, PhD, mufnal@wum.edu.pl Adrian Drapała, MD, PhD, adrapala@wum.edu.pl Kinga Jaworska, MD, PhD kinga.jaworska@wum.edu.pl Marek Konop, MSc, PhD, marek.konop@wum.edu.pl Janusz Skrzypecki, MD, PhD, janusz.skrzypecki@wum.edu.pl

2. BASIC INFORMATION

Year and semester of studies	Ist year, IInd semester	**Number of ECTS credits**	3

FORMS OF CLASSES **Contacting hours with academic teacher**	**Number of hours**	**ECTS credits calculation**
Lecture (L)	10 (8-in e-learning)	0,3
Seminar (S)	9	0,3
Discussions (D)	-	-
e-learning (e-L)	-	-
Practical classes (PC)	16	0,6
Work placement (WP)	-	-
Unassisted student's work		
Preparation for classes and completions	55	1,8

3. COURSE OBJECTIVES

O1	The physical basis of the functioning of human body and the impact of physical factors on human body.
O2	Biomechanics of chewing and basic properties of dental materials.
O3	The physics of dental diagnostic tests.

4. STANDARDS OF LEARNING – DETAILED DESCRIPTION OF EFFECTS OF LEARNING

Code and number of effect of learning in accordance with standards of learning	**General learning effects:**
Knowledge – Graduate* knows and understands:	
B.W7.	principles of statics and biomechanics in relation to the human organism
B.W8.	mechanics of the masticatory apparatus
B.W9.	methods of imaging tissues and organs and the principles of operation of diagnostic devices used for this purpose
B.W10.	principles of operation of ultrasonic devices
B.W11.	principles of photometry and optical fibers as well as the use of light sources in dentistry
B.W12.	principles of management of lasers in dentistry
C.W25.	composition, structure, method of bonding, properties, purpose and method of using dental materials
Skills– Graduate* is able to:	
B.U2.	interpret the physical phenomena occurring in the masticatory system
B.U3.	use physical processes appropriate to the work of a dentist

5. ADDITIONAL EFFECTS OF LEARNING

Number of effect of learning	**Effects of learning in time**
Knowledge – Graduate knows and understands:	
K1	-
Skills– Graduate is able to:	
S1	-
Social Competencies – Graduate is ready for:	

SC1	-

6. CLASSES

Form of class	Class contents	Effects of Learning
Lectures	L1 – Lecture 1: Introduction to biophysics. Physics vs. Biology. Biophysics of respiratory, circulation, nervous and digestive system. Definition of Biophysics, Biology and Physics. The role of biophysics in experimental and clinical sciences. Biophysics of the respiratory, circulatory, nervous and digestive systems.	B.W7., B.W9.
	L2 – Lecture 2: Electricity - electric field, potential, basic definitions and units: electricity, Ohm's law. Electrical properties of living tissues. Electric current - basic definitions and units. Ohm's law, electrical resistance, types of conductors. Electrical model of the cell membrane, ionic conductivity. Membrane channels, equilibrium potential, membrane potential. Action potential. Cardiac conduction system. Electroencephalography. Electrotherapy - treatment options. Electrostimulation of the heart. Current treatments in dentistry.	B.W7.
	L3 – Lecture 3: Principles of static and biomechanics applied in dentistry - biomechanics of masticatory organs, basics of statics and mechanics of the human body, force and moment of force. Concept of biomechanics. The role of the skeletal system in motor function. The role of muscles in motor activity. Types of weights in the musculoskeletal system. Elastic deformation, inelastic deformation, Hooke's law, Young's modulus, Poisson's number. Resistance and friction. Levers. The stomatognathic system and biomechanics of the masticatory organ.	B.W7., B.W8.
	L4 – Lecture 4: Introduction to photometry. Basic photometric quantities. Spectrum of visible light. Light and health - diurnal rhythms. Color vision - basic definitions, attributes and division of colors, methods of combining colors. Assessment of tooth color. Optical illusions - color as a mental impression.	B.W7., B.W11., B.W12.
	L5 – Lecture 5: Diagnostic imaging methods - X-ray diagnostics, ultrasonography, computed tomography, nuclear methods in medical imaging. Medical imaging - main applications. Factors affecting the quality of medical images. Image processing and analysis. X-radiography, properties of X-rays. Ultrasonography - physical phenomena, types of presentation, examples. Computed tomography - physical phenomena, features of the examination, contraindications. Magnetic resonance imaging - physical phenomena, features of the study. Scintigraphy, positron emission tomography - physical phenomena, features of the study.	B.W9., BW.10.
Seminars and exercises		
Seminars	S1 – Seminar 1: Fundamentals of materials science and methods used in materials science. Materials and intermolecular forces - physical basis, thermal expansion of dental fillings, galvanic cells in the oral cavity.	B.U2., C.W25.
	S2 – Seminar 2: Basics of prosthetics - construction and types of prostheses, states of stresses, deformations, and displacements as well as bending moments.	B.W7., B.W8., B.U2.

	S3 – Seminar 3: Lasers and optical fibers.	B.W11., B.W12.
Exercises	E1 – Exercise 1: Photometry - physical basis, analysis of the brightness of various surfaces.	B.W11, B.W12, B.U2
	E2 – Exercise 2: X-ray diagnostics - physical basis, dental panoramic radiograph analysis.	B.W9., B.U3.
	E3 – Exercise 3: Function and methods of cardiovascular and respiratory examination - hemodynamics, electrocardiology, spirometry.	B.W7., B.W8., B.U3.
	E4 – Exercise 4: Summary of the course.	B.W7.-BW.12., C.W25.

7. LITERATURE

Obligatory

1. Daviodovits P.: Physics in Biology and Medicine (3rd ed.), Harcourt Academic Press, An Imprint of Elsevier, 2008
2. Herman I.P.: Physics of the Human Body, Springer, Berlin-Heidelberg-New York, 2007
3. Ronto G., Tarjan I. (Eds.): An Introduction to Biophysics with Medical Orientation, (3rd ed.), Akadémiai Publishing Company, Budapest, 1999

Supplementary

1. Hobbie R.K., Roth B.J.: Intermediate Physics for Medicine & Biology (4-th ed.), Springer, 2007
2. Malmivuo J., Plonsey R.: Bioelectromagnetism, - Principles and Applications of Bioelectric and Biomagnetic Fields. New York, Oxford University Press,

8. VERIFYING THE EFFECT OF LEARNING

Code of the course effect of learning	Ways of verifying the effect of learning	Completion criterion
B.W7.-B.W12., C.W25. B.U2., B.U3.	1. Verbal or written checking of preparation for each seminar or exercise. 2. Preparation of the presentation. The content, method of delivery and the ability to discuss are assessed. 3. Preparation of papers and other written assignments commissioned by lecturers. Fulfillment of the conditions in point. 1, 2 and 3 allows you to approach to the final test. Examination test (50 single-choice questions) checks acquire content presented in lectures, seminars and exercises. **The first and second deadlines have a test form. "Conditional exam" may take place only with the consent of Head of the Department.**	Active participation in classes assessed on the basis of a short checking test. ≥ 60% of the maximum number of points

9. ADDITIONAL INFORMATION

1. Person responsible for teaching: Marcin Ufnal, MD, PhD (mufnal@wum.edu.pl)
2. Attendance at lectures, seminars and exercises is obligatory (attendance list).
3. The student is entitled to 1 unexcused absence. Other absences must be confirmed by a sick leave, which must be delivered to the Department's Secretariat within 7 days of returning to the University.
4. Any absence from class (including excused absences) must be made up. The form of the class to be made up must be defined with the Assistant in charge of that class.

5. Please arrive at the class on time. Being late over 15 minutes is treated as absence. It is strictly forbidden to use cell phones during the classes.
6. Exam - one-choice test, passed ≥60% of the maximum number of points.
7. Information about the Course will be posted on the Department's website: http://physiology.wum.edu.pl
8. Students Research Scientific Group of Experimental Cardiology (contact: professor Marcin Ufnal, MD, PhD- mufnal@wum.edu.pl)

ATTENTION

The final 10 minutes of the last class in the block/semester/year should be allocated to students' Survey of Evaluation of Classes and Academic Teachers