**SYLLABUS**

**2021/2022**

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| **Name of a course/module** | **Biophysics** |
| **Faculty of**  | **Medicine with Division of Dentistry and Division of Medical Education in English** |
| **Name** **of a field of study** | THE SCIENTIFIC FUNDAMENTALS OF MEDICINE |
| **Level of education** | UNIFORM MASTER'S |
| **Form of study** | Stationary |
| **Language of instruction** | English |
| **Type of course** | obligatory ☒ facultative □ |
| **Year of study/Semester** | I ☒ II □ III□ IV □ V □ VI □ | 1 ☒ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8 □ 9□ 10 □ 11 □ 12 □ |
| **Number of didactic hours of classes with division for forms of teaching** | 10 hours of lectures, 25 hours of classes, 10 hours of seminars |
| **Assumptions and aims of the course** | To familiarize students with:- Biophysical fundamentals of the construction and operation of the basic cellular structures, some tissues and organs and the body as a whole.- Physical phenomena occurring in the human body- Mechanisms and effects of physical factors on the human body- Physical fundamentals of modern diagnostic and therapeutic methods |

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| **Symbol of** **education outcomes in accordance with the standards** | **Description of directional effects of education** | **Methods of verification of achieved learning outcomes** |
|  | **Knowledge (according to the detailed education outcomes)** |  |
| B.W5. | physical laws describing flow of a liquid and factors affecting vascular resistance of blood flow | **Continuous assessment by the teacher, credit/test, final exam** |
| B.W6. | natural and artificial sources of ionizing radiation and its interaction with matter; |
| B.W8. | physical bases of non-invasive imaging techniques; |
| B.W9.  | physical bases of particular therapeutic techniques including ultrasounds and irradiations; |
| B.W24.  | basics of nerve system conduction and stimulation, higher functions of nerve system, physiology of smooth and striated muscles, blood role; |
| B.W25.  | functions and mechanisms of all organs and systems of the human body including: cardiovascular system, respiratory system, digestive system, urinary system, integumentary system; interdependence of organs and systems; |
| B.W32.  | basic methods of statistical analysis used in population and diagnostic researches; |
| B.W34.  | principles of conducting scientific, surveillance and experimental study as well as in vitro research for the development of medicine. |
|  | **Skills (according to the detailed education outcomes)** |  |
| B.U1.  | making use of physical laws in order to explain the impact of external factors such as temperature, acceleration, pressure, electromagnetic field and ionizing radiation on the organism and its elements; | **Continuous assessment by the teacher, credit/test, final exam** |
| B.U2.  | evaluating harmful effects of ionizing radiation dose and complying with the principles of radiological protection; |
| B.U3.  | calculating molar and percentage concentration of the compounds as well as concentration of substances in single- and multi-component isotonic solutions;  |
| B.U7.  | describing changes in the organism functioning caused by homeostasis dysfunction, especially by finding organism response to physical exertion, exposure to high and low temperatures, loss of blood or water, sudden erect position, transition from sleep to waking;  |
| B.U10.  | using a simple measuring apparatus and evaluating accuracy of measurements; |
| B.U14.  | planning and performing simple scientific research, interpreting the results and drawing conclusions. |
|  | **Social competence (according to the general education outcomes)** |  |
| K1 | He /She recognizes his/her own diagnostic and therapeutic limitations, educational needs, planning of educational activity | **Continuous assessment by the teacher** |
| K2 | He /She is able to work in a team of professionals, in a multicultural and multinational environment |
| K3 | He /She implements the principles of professional camaraderie and cooperation with representatives of other professionals in the range of health care |
| K4 | He /She observes doctor-patient privilege; and patient rights |

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| **ECTS points** | 2,5 |
| **Student Workload** |
| **Form of Activity** | **Number of hours to complete the activity** |
| **Activities that require the participation of (academic) teacher** |
| 1. Realization of the course: lecture
 | 10 |
| 1. Realization on of the course: seminar
 | 10 |
| 1. Realization of the course: classes
 | 25 |
| 1. exam
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| 1. electives
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|  |  total of hours 45 |
| **Self-study:**  |
| 1. Preparation for classes
 | 30 |
| 1. Preparation for credits / tests
 | 15 |
| 1. Preparation for the exam / final test
 | 15 |
|  |  total of hours 60 |

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|  **Course contents** |
| **Topics****Lectures**1. Laws of thermodynamics a. I law of thermodynamics - equivalence of work and heat, internal  energy b. II law of thermodynamics for open systems - stationary state, principle of minimum entropy - biological systems as open systems1. source of entropy and dissipation of energy

 d. coupled processes and their significance in biology 2. Molecular interactions and their role in forming of biological structures - electrostatic forces - hydrogen bonds - Van der Waals forces - hydrophobic effects 3. Structure of biological membranes and their properties: - major components of biological membranes - physical properties of proteins and lipids - model of Singer and Nicolson - properties of biological membranes resulting from physical properties of  their components4. Membrane transport:  - passive transport - active transport 5. Bioelectric phenomena in membranes  - basic features and classification of ionic channels - resting potential - action potential - mechanism of propagation of action potential in axon8. Physical bases of NMR imaging and NMR spectroscopy  9. Effects of temperature and humidity on human organism a. mechanism of heat exchange between the organism and environment, (conduction, convection, infrared radiation, evaporation) b. thermoregulation10. Influence of non-ionizing radiation on human organism**Classes**l. Law of radioactive disintegration, natural and artificial radioisotopes,  determination of activity of samples2. Effect of ionizing radiation on matter- absorption of corpuscular radiation- attenuation of radiation - use of radiation in medicine3. Methods of detection of radiation and statistics of measurements4. Biophysics of human voice: physical and physiological features of sound and  their interrelations5. Physical bases of electrocardiography and description of characteristic  elements of ECG6. Measurement of arterial pressure: factors inf1uencing the value of arterialpressure.8. Methods of measurements of concentration of solutions:- spectrometric method- polarimetric method- refractometric method10. Analysis of emission and absorption spectra11. Creation of images in optical systems12. Mechanism of image generation in human eye13. Polarization of light, rotation of polarization plane, optical isomerism14. Application of computer programs for registration and analysis of ECG, pulse  rate, tension between points of skin, spectral analysis of sound, pH of  solutions.15. Weakening of the laser beam passing through the solid matter**Seminars**Introduction to the mathematical methods used in Biophysics | **Form** *(lectures, classes etc.…)* |
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| **A list of recommended and optional books** |
| BiophysicsThe obligatory books:1. Martin Hollins Bath Advanced Science - Medical Physics (University of Bath Science)
* Publisher: Nelson Thornes Ltd; 2nd edition (September 28, 2001)
* Language: English
* ISBN-10: 0174482531
* ISBN-13: 978-0174482536
1. Roland Glaser, "Biophysics", 2nd edition; Springer Verlag, 2012
* ISBN-10: 3642252117
* ISBN-13: 978-3642252112

The optional books:1. Paul Davidovits, "Physics in Biology and Medicine",
* 4th edition, Academic Press, 2012
* ISBN-10: 0123865131
* ISBN-13: 978-01238651372)
1. Russell K. Hobbie and Bradley J. Roth - Intermediate Physics for Medicine and Biology,
* 4th Edition
* Publisher: Springer; 4th edition (March 12, 2007)
* Language: English
* ISBN-10: 038730942X

ISBN-13: 978-0387309422 |

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| **Conditions for receiving credit** |
| **Criteria and number of points assigned for exercises,****the colloquium (test) and the exam****General Rules & Regulations**1. The course in Biophysics consists of laboratory classes (25 hours), seminars (10) and lectures (10 hours), ending and with an exam.2. Students’ attendance is mandatory. Each absence must be justified and any missed lab class must be redone  at a time  agreed with the course teacher.3. Lab classes are held at the Biophysics Department.4. Objectives of the first lab class:1. Introducing students to the rules and regulations of the course
2. Safety procedures at the laboratory
3. Dividing students into groups and assignment of tasks
4. Course overview
5. Recommended reading:

Paul Davidovits – “Physics in Biology and Medicine”Roland Glaser – “Biophysics”**Requirements for obtaining a credit in Biophysics**1. Laboratory classes are divided into 3 thematic modules.2. Students’ achievements in the practical part are evaluated assessed on the basis of theoretical background and practical performance, as follows:Experiments  conducted by students individually or in  groups; students’ analysis of the results and the presentation;Report according to a formula given in the handbook - available from the website of the Department of Biophysics).3. Each student can receive 2 bonus points for outstanding performance at particular lab meetings.4. At the end of each semester, following the course of lab practice, students are required to pass a test in the subject areas covered by the lab classesand lectures, where the maximum score is 40 points, of which 30 are for practice topics and 10 for lecture subjects.5. The student’s final grade for lab classes is the sum of lab credits, bonus points, and test points. The available maximum is:18(3x6)+40=**58**6. Students who completed all the lab classes and received minimum 24 points are allowed to take the final exam.7. One retake opportunity is given to students with less than 24 test points. If the retake result is still below 24 points, no credit is awardedfor Biophysics and the student does not qualify to take the final   exam.8. Students who received a total of **at least 42 points** are exempt from the Exam and receive a ‘very good’ grade (**5)****The Exam** 1. The Exam takes a form of different test item formats (the mixture of the multiple-choice, essay or calculation questions)2. Each written exam test can be seen by students only at the time agreed by Head of Department of Biophysics and students’ representative.3. Students receive the following grads depending on the number of points achieved in the exam:

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| % of points from the exam | Grading |
| 0-59 | 2 |
| 60 - 68 | 3 |
| 69 - 76 | 3+ |
| 77 - 84 | 4 |
| 85 -90 | 4+ |
| 91 - 100 | 5 |

 4. In all other matters the decision rests with the Head of the Department of Biophysics.  |

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| Date of issue**:** | *2021* | Course coordinator or the head of the department where the course is held | *Dr hab. Maria Karpińska* |