**description of the course of study**

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| **Course code** | **0912-7LEK-B2.1-Bf** | |
| **Name of the course in** | Polish | **Biofizyka** |
| English | **Biophysics** |

1. **LOCATION OF THE course OF STUDY within the system of studies**

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| **1.1. Field of study** | Medicine |
| **1.2. Mode of study** | Full-time |
| **1.3. Level of study** | Uniform Master’sstudies |
| **1.4. Profile of study\*** | General academic |
| **1.5. Person preparing the course description** | dr hab. Tadeusz Kosztołowicz, prof. UJK |
| **1.6. Contact** | tadeusz.kosztolowicz@ujk.edu.pl |

1. **General characteristicS of the course of study**

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| **2.1. Language of instruction** | English |
| **2.2. Prerequisites\*** | The basics of Physics, Chemistry and Biology in the scope of the secondary school |

1. **DETAILED CHARACTERISTICS OF THE COURSE OF STUDY**

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| * 1. **Form of classes** | | Lecture- 25 (including 5 hours e-learning), classes- 15, laboratories-15 |
| * 1. **Place of classes** | | Courses in the teaching rooms of the UJK. The Faculty of Mathematics and Natural Sciences |
| * 1. **Form of assessment** | | Credit/ exam, laboratory/ classes – credit with grade |
| * 1. **Teaching methods** | | Lecture: informative, problematic, demonstration, film, laboratory, measurement |
| * 1. **Bibliography** | **Required reading** | Davidovits Paul, Physics in Biology and Medicine, 978-0-12-386513-7, Elsevier, 2013. |
| **Further reading** | 1. Cotterill Rodney, Biophysics an Introduction, 978-0-471-48538-4, John Wiley & Sons, 2002.  2. Glaser Roland, Biophysics, 81-8128-126-8, Springer Verlag, 2004. |

1. **Objectives, syllabus CONTENT and intended LEARNING outcomes**

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| * 1. **Course objectives *(including form of classes)***   C1 - understanding the physical basis of the mechanisms that governs physiological processes in living organisms: L, C, La  C2 – familiarizing with the physical basis of the functioning of organs and organ systems of the human body: L, C  C3 – acquiring the knowledge of physical methods in medical research: L, C, La  C4 - understanding the mechanisms and effects of physical as well as biophysical environmental factors on the human body: L, C  C5 – planning and carrying out the measurements as well as analyzing the results: La |
| * 1. **Detailed syllabus *(including form of classes)***   **Lecture: C1, C2, C3, C4**  Basic concepts in mechanics. Staticforces. Equilibrium and stability. Stability of human body. Skeletalmuscles. Levers, the elbow, the hip, the back. Translational and angularmotion. Friction. Verticaljump. Energy consumed in physicalactivity. Forces on curvedpath. Pendulum. Energy in running. Elasticity of materials. Longintudalstretch and compression. A spring. Bonefracture. Fracturedue to fall. Fluids. Force and pressure in fluid. Pascal’sprinciple. Archimedes’ principle. Surface tension. Motion of fluids. Bernoulli’sequation. Viscosity and Poiseuille’s law. Turbulentflow. Circulation of the blood. Blood pressure. Power produced by the heart. Heat and kinetictheory. Kinetictheory of matter. Transfer of heat. Diffusion. Diffusionthroughmembranes. The respiratory system. First and secondlaws of thermodynamics. Thermodynamics of livingsystems. Energy requirements of people. Energy from food. Regulation of body temperature. Convection, radiation, evaporation. Waves and sound. Properties of waves, reflection, refraction, interference, diffraction. Hearning and the ear. Doppler effect. Clinicaluses of sound. Ultrasonicwaves. Basic concepts in electricity and magnetism. The nervous system. Electricaltechnology in medicalresearch. The electrocardiograph, the electroencephalograph. Physiologicaleffects of electricity. Basic concepts in optics. Nature of light. Structure of the eye. Lens system of the eye. Accomodation. Defects in vision. Atomic and nuclear physics. The atom. Spectroscopy. X-rays. Radiation therapy. Nuclear magnetic resonance.  **e-learning:**  Basic concepts in mechanics. Static forces. Equilibrium and stability.  Translational and angular motion. Friction. Forces on curved path. Pendulum. Elasticity of materials. Longintudal stretch and compression.  **Classes: C1, C2, C3, C4**  Stability of human body. Levers, the elbow, the hip, the back. Energy consumed in physicalactivity. Pendulum. Energy in running. Bonefracture. Fracturedue to fall. Force and pressure in fluid. Viscosity and Poiseuille’s law. Circulation of the blood. Blood pressure. Power produced by the heart. Transfer of heat. Diffusion. Diffusionthroughmembranes. The respiratory system. Thermodynamics of livingsystems. Energy requirements of people. Energy from food. Properties of waves, reflection, refraction, interference, diffraction. Doppler effect. Electricity and magnetism: the nervous system. Lens system of the eye. Accomodation. Defects in vision. The atom. Spectroscopy. Energy of photon.  **Laboratory: C1, C3, C5**  The studentsperform 4-6 exercises from the following list:  1. Determiningsurfacetension of liquids with the application of torsionbalance.  2. Study of inviscidflow. TestingBernoulli’sprinciple.  3. Study of the dependence of glycerineviscosity on temperature. Determination of activationenergy.  4. Study of electricalpotentials in membranesystems.  5. Study of the magnetic field using the Hall probe.  6. Study of the topography of tissueusingatomicforcemicroscopy.  7. Study of diffraction and absorption of ultrasonicwaves.  8. Study of polarization of light. Testing the Malus’ law. |

**4.3 Intended learning outcomes**

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| **Code** | **A student, who passed the course** | **Relation to learning outcomes** |
| within the scope of **knowledge** the graduate knows and understands: | | |
| W 1 | the physical laws describing the flow of fluids and factors affecting the vascular resistance of blood flow | B. W5. |
| W 2 | natural and artificial sources of ionizing radiation and its interaction with the matter; | B. W6. |
| W 3 | the physical, chemical and molecular basis of how the organs of the senses function; | B. W7. |
| W 4 | the physical basis of non-invasive imaging methods; | B. W8. |
| W 5 | the physical principles of selected therapeutic techniques, including ultrasound and radiation; | B. W9. |
| W 6 | the possibilities of modern telemedicine as a tool to support the work of a physician; | B. W28. |
| within the scope of **ABILITIES**the graduate knows how to**:** | | |
| U 1 | use the knowledge of the laws of physics to explain the impact of external factors such as temperature, acceleration | B. U1 |
| U 2 | assesse harmful ionizing radiation dose and applies the principles of radiation protection; | B. U2 |
| U 3 | operate simple measuring instruments and evaluates the accuracy of measurements; | B. U9 |
| U 4 | use databases, including online ones, and searches for necessary information using available tools; | B. U10 |
| U 5 | plan and perform basic scientific research, interprets the results and draws conclusions. | B. U13 |
|  | within the scope of **SOCIAL COMPETENCE**, the graduateisable to: |  |
| K01 | establish and maintaindeep and respectfulcontact with the patient and show understandingtowardsideological and culturaldifferences; | H.S1 |
| K02 | do whatisright for the patient; | H.S2 |
| K03 | respectmedicalconfidentiality and patient’srights; | H.S3 |
| K04 | takeactionsconcerning the patient on the basis of ethicalprinciples, beingaware of socialconditions and restrictionsresulting from illness; | H.S4 |
| K05 | recognizehis/herownlimitations and self-evaluateeducationaldeficiencies and needs; | H.S5 |
| K06 | promotehealthylifestyle; | H.S6 |
| K07 | usereliableinformationsources; | H.S7 |
| K08 | conclude on the basis of ownsurveys and observations; | H.S8 |
| K09 | introducerules of socialconduct and teamwork to the group of specialists, includingspecialists form othermedicalprofessionsalso in the multicultural and multinational environment; | H.S9 |
| K10 | giveopinionsconcerningvariousaspects of professionalactivity; | H.S10 |
| K11 | takeresponsibility for owndecisionsmadeduringprofessionalactivitiesincludingownsafety and safety of otherpeople; | H.S11 |

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| * 1. **Methods of assessment of the intended learning outcomes** | | | | | | | | | | | | | | | | | | | | | |
| **Teaching**  **outcomes**  ***(code)*** | **Method of assessment (+/-)** | | | | | | | | | | | | | | | | | | | | |
| **Exam oral/written\*** | | | **Test\*** | | | **Project\*** | | | **Effort**  **in class\*** | | | **Self-study\*** | | | **Group work\*** | | | **Others\*** | | |
| ***Form of classes*** | | | ***Form of classes*** | | | ***Form of classes*** | | | ***Form of classes*** | | | ***Form of classes*** | | | ***Form of classes*** | | | ***Form of classes*** | | |
| *L* | *C* | *...* | *L* | *C* | *...* | *L* | *C* | *...* | *L* | *C* | *...* | *L* | *C* | *...* | *L* | *C* | *...* | *L* | *C* | *...* |
| W1 | + |  |  |  | + |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | + |
| W2 | + |  |  |  | + |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | + |
| W3 | + |  |  |  | + |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | + |
| W4 | + |  |  |  | + |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | + |
| W5 | + |  |  |  | + |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | + |
| W6 | + |  |  |  | + |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | + |
| U1 | + |  |  |  | + |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | + |
| U2 | + |  |  |  | + |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | + |
| U3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | + |
| U4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | + |
| U5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | + |
| K01-K11 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | + | + | + |

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| * 1. **Criteria of assessment of the intended learning outcomes** | | |
| **Form of classes** | **Grade** | **Criterion of assessment** |
| **lecture (L)** | **3** | Exam-test, 61-68% of correct answers |
| **3,5** | Exam -test, 69-76% of correct answers |
| **4** | Exam -test, 77-84% of correct answers |
| **4,5** | Exam -test, 85-92% of correct answers |
| **5** | Exam -test, 93-100% of correct answers |
| **classes (C)\*** | **3** | 61-68% Pass the test on satisfactory grade and credit reports of the classes |
| **3,5** | 69-76% Pass the test on more than satisfactory grade and credit reports of the classes |
| **4** | 77-84% Pass the test on good grade and credit reports of the classes |
| **4,5** | 85-92% Pass the test on more than good grade and credit reports of the classes on time |
| **5** | 93-100% Pass the test on very good grade and credit reports of the classes on time |
| **others (...)\*** | **3** | 61-68% Pass the laboratory exercises reports on a satisfactory grade |
| **3,5** | 69-76% Pass the laboratory exercises reports on more than a satisfactory grade |
| **4** | 77-84% Pass the laboratory exercises reports on a good grade |
| **4,5** | 85-92% Pass the laboratory exercises reports on more than a good grade |
| **5** | 93-100% Pass the laboratory exercises reports on a very good grade |

1. **BALANCE OF ECTS CREDITS – STUDENT’S WORK INPUT**

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| **Category** | **Student's workload** |
| **Full-time**  **studies** |
| *NUMBER OF HOURS WITH THE DIRECT PARTICIPATION OF THE TEACHER /CONTACT HOURS/* | **55** |
| *Participation in lectures\** | **20** |
| *Participation in classes, seminars, laboratories\** | **30** |
| *Preparation in the exam/ final test\** |  |
| *Others\** | **51** |
| *INDEPENDENT WORK OF THE STUDENT/NON-CONTACT HOURS/* | **45** |
| *Preparation for the lecture\** |  |
| *Preparation for the classes, seminars, laboratories\** | **25** |
| *Preparation for the exam/test\** | **20** |
| *Gathering materials for the project/Internet query\** |  |
| *Preparation of multimedia presentation* |  |
| *Others (please specify e.g. e-learning)\** |  |
| *TOTAL NUMBER OF HOURS* | **100** |
| ECTS credits for the course of study | **4** |

***\*delete as appropriate***

1 e-learning (withoutparticipation of the lecturer)

***Accepted for execution*** *(date and legible signatures of the teachers running the course in the given academic year)*

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