**SYLLABUS**

**regarding the qualification cycle FROM 2021 TO 2025**

1. Basic Course/Module Information

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| --- | --- |
| Course/Module title | *Biophysics* |
| Course/Module code \* |  |
| Faculty (name of the unit offering the field of study) | College of Natural Sciences |
| Name of the unit running the course | Institute of Physics |
| Field of study | Diagnostic systems in medicine |
| Qualification level | First-cycle studies |
| Profile |  |
| Study mode | Full-time |
| Year and semester of studies | Year I, semester II |
| Course type |  |
| Language of instruction | English |
| Coordinator | Prof. dr hab. Marian Cholewa |
| Course instructor | dr Mirosław Łabuz, dr Krzysztof Kucab |

\* - as agreed at the faculty

1.1.Learning format – number of hours and ECTS credits

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Semester  (n0.) | Lectures | Classes | Colloquia | Lab classes | Seminars | Practical classes | Internships | others | **ECTS credits** |
| 2 |  | 30 |  |  |  |  |  |  | **4** |

1.2. Course delivery methods

☒ classes conducted in a traditional way

☒ classes that involve remote education methods and techniques

1.3. Course/Module assessment (exam, pass with a grade, pass without a grade)

Lecture - pass without grade

Classes - pass with a grade

Laboratory classes - pass with a grade

2. Prerequisites

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| Physics – first-semester course  Biology: human biology – first-semester course |

3. Objectives, Learning Outcomes, Course Content, and Instructional Methods

3.1. Course/Module objectives

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| O1 | Mastering the theoretical basics of physical phenomena occurring in the human body |
| O2 | Knowledge of physical processes occurring and used in medicine |

3.2. Course/Module Learning Outcomes (to be completed by the coordinator)

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| --- | --- | --- |
| Learning Outcome | The description of the learning outcome  defined for the course/module | Relation to the degree programme outcomes |
| LO\_01 | The student knows and understands the physical laws behind the phenomena occurring in the human body | K\_W02 |
| LO\_02 | The student knows and understands the physical basis of X-ray, CT, PET, USG, and MRI equipment | K\_W04 |
| LO\_03 | The student knows the construction of the elements of X-ray, CT, PET, USG, MRI equipment, and basic laboratory equipment and understands the principle of their operation | K\_W07 |
| LO\_04 | The student understands the need to constantly improve their qualifications and self-improvement related to the continuous development of medicine | K\_W08 |
| LO\_05 | The student is able to use the known theorems and methods to solve practical research problems | K\_U01 |
| LO\_06 | The student is able to use an optical microscope, a viscometer, a refractometer, and basic laboratory equipment | K\_U02 |
| LO\_07 | The student is able to choose the appropriate analytical technique for the presented research problem, prepare a research report and interpret the results | K\_U06 |
| LO\_08 | The student is ready to cooperate with specialists in physics, biophysics, and medicine | K\_K01 |

**3.3. Course content (to be completed by the coordinator)**

1. Lectures

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| Content outline |
| Types of intermolecular interactions; biological membranes and their properties. |
| The physical basis of transport across membranes, membrane potentials, and passive and active transport. |
| Light and types of electromagnetic waves. The structure of the eye; the physical basis of the vision process. |
| Physical properties of muscles, muscle power and efficiency, Hill's equation, mechanism of muscle contraction. |
| Physical basis of sound recording and properties of sound waves. Ultrasound - application in medicine. |
| Biophysics of the circulatory system. Physical basis of electrocardiography. |
| Interaction of ionizing radiation with matter. Dosimetry and radiation protection.  Application of ionizing radiation in medicine - X-ray, CT, PET. |
| Physical basis of magnetic resonance. Application in medicine. |

1. Classes, tutorials/seminars, colloquia, practical classes

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| Content outline |
| Radioactivity. The effect of radiation on the human body. Absorbed, equivalent and effective dose. |
| Fundamentals of acoustics. Hearing acoustics. The physical basis of ultrasonography. Attenuation of the acoustic wave due to reflection and absorption in the tissue. |
| Basics of linear optics. Simple optical instruments. Basics of visual photometry. Basics of the optics physiology . |
| Work, power, energy. Determination of work and study of the distribution of forces in the model of skeletal-muscular levers. Human energy expenditure. |
| Elements of statics and fluid mechanics. Capillary phenomena. Viscous liquids. Blood flow. |
| Fundamentals of thermodynamics. |

1. Laboratory classes

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| Content outline |
| Determination of the viscosity coefficient of a liquid using a Rheo viscometer acc. to Höppler . |
| Microscopic measurements of tissue preparations and bacteria. |
| Measurements of the magnetic field generated by circuits with the current. |
| Ultrasound absorption in the air. |
| Sugar concentration measurements. |
| Speech sound spectrum analysis using the PRAAT program. |
| Lens defect testing. |
| Eye resolving power test. |
| Determination of the electrical axis of the heart - electrocardiography (ECG). |

3.4. Methods of Instruction

e.g.

*Lecture: a problem-solving lecture/a lecture supported by a multimedia presentation/ distance learning*

*Classes: text analysis and discussion/project work (research project, implementation project, practical project)/ group work (problem-solving, case study, discussion)/didactic games/ distance learning*

*Laboratory classes: designing and conducting experiments*

Lecture: Multimedia lecture

Classes: problem-solving, discussion

Laboratory classes: performing experiments (in the form of an analysis of ready-made data in case of remote learning), reports

4. Assessment techniques and criteria

4.1 Methods of evaluating learning outcomes

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| Learning outcome | Methods of assessment of learning outcomes (e.g. test, oral exam, written exam, project, report, observation during classes) | Learning format (lectures, classes,…) |
| LO-01 | observation during classes, colloquium, essay | Lectures, classes |
| LO-o2 | observation during classes, essay | Lectures |
| LO-o3 | observation during classes, essay, reports | Lectures, laboratory classes |
| LO-o4 | observation during classes, colloquium, essay, reports | Lectures, classes, laboratory classes |
| LO-o5 | observation during classes, colloquium, reports | Classes, laboratory classes |
| LO-o6 | observation during classes, reports | laboratory classes |
| LO-o7 | observation during classes, reports | laboratory classes |
| LO-o8 | Observation during classes | Lectures, laboratory classes |

4.2 Course assessment criteria

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| **Classes:**  1. full participation and activity in classes  2. passing two tests, active participation in classes  The final grade is the arithmetic mean of grades from 2 tests in a semester. Student activity in class is also taken into account.  Punctation:  3 - 51-60% points  3+ - 61-70% pts.  4 - 71-80% pts.  4+ - 81-90% pts.  5 - 91-100% points  **Laboratory classes:**  1. Performing all experiments.  2. Submitting reports.  Rating range: 2.0 - 5.0  **Lectures** :  1. test pass and open questions:  A: Questions about the messages to remember;  B: Knowledge-to-understand questions;  C: Solving a typical written task;  D: Solving an untypical written task;  - for the insufficient solution of tasks only from A and B = grade 2.0  - for solving tasks only from A and B, the possibility of obtaining a maximum grade of 3.0  - for solving tasks from A + B + C, the possibility of obtaining a maximum grade of 4.0  - for solving tasks from A + B + C + D, the possibility of obtaining a 5.0 grade  **Skill assessment**  5.0 - the student actively participates in classes, recognizes and can correctly name the biophysical phenomena in the human body, and assess the correctness of the biophysical functioning of the human body. Skillfully uses basic laboratory techniques,  4.5 - the student actively participates in classes, with a little help from the lecturer recognizes and can correctly name the biophysical phenomena in the human body, and assess the correctness of the biophysical functioning of the human body. Uses basic laboratory techniques well  4.0 - the student actively participates in classes, with minor corrections from the lecturer, making minor errors in recognizing biophysical phenomena in the human body. Uses laboratory techniques well  3.5 - the student participates in classes, with numerous corrections and lecturer’s instructions, recognizes and is able to correctly name biophysical phenomena in the human body, often making mistakes when using laboratory techniques  3.0 - the student participates in classes, with numerous corrections and lecturer's instructions, recognizes and is able to correctly name biophysical phenomena in the human body, very often making mistakes when using laboratory techniques  2.0 - the student passively participates in classes, makes gross mistakes in the recognition and naming of biophysical phenomena |

5. Total student workload needed to achieve the intended learning outcomes

– number of hours and ECTS credits

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| --- | --- |
| Activity | Number of hours |
| Scheduled course contact hours | 30 |
| Other contact hours involving the lecturer (consultation hours, examinations) | 3 |
| Non-contact hours - student's own work (preparation for classes or examinations, projects, etc.) | 52 |
| Total number of hours | 85 |
| Total number of ECTS credits | 4 |

\* One ECTS point corresponds to 25-30 hours of total student workload

6. Internships related to the course/module

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| --- | --- |
| Number of hours | n/ a |
| Internship regulations and procedures | n/ a |

7. Instructional materials

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| Compulsory literature:   1. D. Halliday, R. Resnick, J. Walker, *Fundamentals of Physics. Extended,* Wiley 2021 2. S. Tabakov, C. Lewis, R. Padovani, S. Keevil, *Introduction to Medical Physics*, CRC Press 2022 |
| Complementary literature:   1. S. A. Kane, N. Donaldson, B. Gelman, *Introduction to Physics in Modern Medicine*, CRC Press 2020 2. R. Cotteril, *Biophysics: An Introduction,* Wiley 2002 |

Approved by the Head of the Department or an authorised person