Appendix No. 1.5 to the Resolution No. 7/2023

of the Rector of the University of Rzeszów

**SYLLABUS**

**regarding the qualification cycle FROM ………TO…..**

**Academic year 2024/2025**

1. Basic Course/Module Information

|  |  |
| --- | --- |
| Course/Module title | Elements of modern physics in biology and medicine |
| 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 | Physics |
| Qualification level | second-cycle studies |
| Profile | General academic |
| Study mode | Stationary |
| Year and semester of studies | Year I, winter semester |
| Course type |  |
| Language of instruction | English |
| Coordinator | Prof. Marian Cholewa |
| Course instructor | Prof. Marian Cholewa, dr Izabela Piotrowska |

\* - 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 - exam

Classes - pass with a grade

2. Prerequisites

|  |
| --- |
| Knowledge of physics and mathematical methods of physics at the level of first-cycle studies. |

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

3.1. Course/Module objectives

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| --- | --- |
| O1 | Presentation of the role of physics in biology and medicine. |
| O2 | Discussion of selected physical phenomena occurring in the human body. |
| O3 | Discussion of selected medical technologies from the point of view of physics. |

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

|  |  |  |
| --- | --- | --- |
| Learning Outcome | The description of the learning outcome  defined for the course/module | Relation to the degree programme outcomes |
| LO\_01 | The graduate understands and recognizes physical mechanisms related to the functioning of the human body | K\_W01 |
| LO\_02 | The graduate understands and recognizes mathematical models related to the functioning of the human body | K\_W02 |
| LO\_03 | The graduate has general knowledge of the study of the functioning of selected human systems using selected medical technologies | K\_W06 |
| LO\_04 | The graduate knows and understands the fundamental dilemmas of the modern development of medical physics | K\_W07 |
| LO\_05 | The graduate knows and understands the ethical conditions related to the scientific activity of a physicist in terms of the application of the acquired knowledge in biology and medicine | K\_W08 |
| LO\_06 | The graduate is able to use knowledge in the field of physics to explain the operation of selected diagnostic technologies by finding the necessary information in the professional literature | K\_U03 |
| LO\_07 | The graduate is able to determine the directions of further development in terms of knowledge and skills in the field of medical physics | K\_U09 |
| LO\_08 | The graduate independently performs the tasks entrusted to him and properly organizes his own work, in the event of difficulties with independent problem-solving, he knows how to consult experts | K\_K02 |
| LO\_09 | The graduate is ready to systematically read the literature on medical physics | K\_K06 |

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

1. Lectures

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| --- |
| Content outline |
| 1. Atoms and light, biological applications of infrared scattering, heating tissue with light, radiometry, and photometry |
| 2. Interaction of photons and charged particles with matter, Compton scattering, coherent scattering, photon attenuation coefficient, energy transfer from photons to electrons |
| 3. Medical applications of X-rays, angiography, mammography, computed tomography |
| 4. Nuclear physics, calculating the absorbed dose based on the radioactive nuclei in the body (MIRD method), computed tomography with emission of single photons, brachytherapy and internal radiation therapy |
| 5. Magnetic resonance, magnetic resonance signal detection, selected  pulse sequences, imaging, chemical shift |

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

|  |
| --- |
| Content outline |
| The classes are related to the topics covered in the lectures. Students solve calculation tasks closely correlated with the content of the lecture. At least one problem is solved for each topic. |

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: standard blackboard lecture/lecture with a multimedia presentation

Classes: standard work on the blackboard, group problem-solving.

4. Assessment techniques and criteria

4.1 Methods of evaluating learning outcomes

|  |  |  |
| --- | --- | --- |
| 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 | Written exam; observation during classes; test | Lectures, classes |
| LO-o2 | Written exam; observation during classes; test | Lectures, classes |
| LO-o3 | Written exam; observation during classes; test | Lectures, classes |
| LO-o4 | Observation during classes | Classes |
| LO-o5 | Observation during classes | Classes |
| LO-o6 | Observation during classes | Classes |
| LO-o7 | Observation during classes | Classes |
| LO-o8 | Observation during classes | Classes |
| LO-o8 | Observation during classes | Classes |

4.2 Course assessment criteria

|  |
| --- |
| Completion of the subject will be confirmed by the degree to which the student has achieved the assumed learning outcomes. Verification of the achieved learning outcomes is controlled on an ongoing basis during the course. The grade obtained from completing the course will enable the assessment of the degree of achieved effects.  Lecture - written exam consists of five issues covering the theoretical and calculation parts. Each issue corresponds to a score of 0 - 4 points. The written part of the exam is passed after the student has scored at least 10 points  Number of points - Rating  18 - 20 - 5.0  17 - 4.5  14 - 16 - 4.0  13 - 3.5  10 - 12 - 3.0  Classes - the final grade is the arithmetic mean of the grades from two tests. Both tests  must be passed. Student activity in class is also taken into account. The method of scoring the colloquium is determined in advance.  Requirements corresponding to individual grades:  **Very good rating**  The student has mastered the full range of knowledge and skills specified in the curriculum. Efficiently uses the acquired information, knows how to use various sources of knowledge, and solves calculation and problem-solving tasks independently. Able to apply acquired knowledge in new situations.  **Good rating**  The student has mastered a large range of relatively complex knowledge and skills. However, the student did not fully master the knowledge specified in the curriculum. Applies the gained knowledge correctly for solving common tasks or problems.  **Satisfactory rating**  The student has mastered the most important information from the point of view of the subject, simple, and easy to learn. Solves typical tasks with the help of the teacher, and knows the basic theorems and formulas.  In the case of remote/hybrid classes, the conditions for passing the course may change. In this case, students will be informed both about the change in the form of crediting and the exact conditions for passing the course right after the start of classes in the remote/hybrid form. |

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

– number of hours and ECTS credits

|  |  |
| --- | --- |
| Activity | Number of hours |
| Scheduled course contact hours | 30 |
| Other contact hours involving the lecturer (consultation hours, examinations) | 5 |
| Non-contact hours - student's own work (preparation for classes or examinations, projects, etc.) | 40 |
| Total number of hours | 75 |
| 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

|  |  |
| --- | --- |
| 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 3. P. Davidovits, *Physics in Biology and Medicine*, Academic Press Inc. 2018 |
| 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