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 | Spectroscopic research methods and preparation of biological objects |
| 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 |  |
| Study mode | Full-time |
| Year and semester of studies | 1st year, winter or summer semester |
| Course type |  |
| Language of instruction | English |
| Coordinator | DSc Józef Cebulski, Associate Professor |
| Course instructor |  |

\* - 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** |
| winter / summer |  | 30 |  |  |  |  |  |  | 5 |

1.2. Course delivery methods

☒ conducted in a traditional way

☒ involving distance education methods and techniques

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

pass with a grade

2. Prerequisites

|  |
| --- |
| Basic knowledge of physics, chemistry and biology. Ability to operate basic research equipment. |

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

3.1. Course/Module objectives

|  |  |
| --- | --- |
| O1 | Familiarizing students with the types of interaction of radiation with matter. |
| O2 | Familiarizing students with spectroscopic techniques used to measure biological objects. |
| O3 | Familiarizing students with selected types of spectrometers, the principle of their operation, operating rules and parameters. |
| O4 | Familiarizing students with the methods of preparation of biological objects for the needs of particular types of spectroscopy. |

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 knows and understands issues in the field of the interaction of radiation with matter, as well as physical parameters and quantities describing these interactions. | K\_W01 |
| LO\_02 | The graduate knows and understands experimental and observational techniques regarding the operation of various types of spectrometers. | K\_W03 |
| LO\_03 | The graduate knows and understands the legal and ethical conditions applicable to work with samples of biological material and related personal data. | K\_W08 |
| LO\_04 | The graduate is able to plan and perform research and experiments with appropriately selected biological objects. | K\_U01 |
| LO\_05 | The graduate is able to critically evaluate the results of experiments and observations, as well as discuss measurement errors. | K\_U02 |
| LO\_06 | The graduate is able to prepare a report on the entire course of the experiment along with the final results and their critical evaluation. | K\_U04 |
| LO\_07 | A graduate is able to work individually and in a team, including taking the role of a leader. | K\_U08 |
| LO\_08 | The graduate is ready to recognize the limitations of his own knowledge and the need to consult experts in the event of difficulties in solving a problem on his own. | K\_K02 |

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

1. Lectures

|  |
| --- |
| Content outline |
| Introduction to spectroscopy and its history. |
| The nature of electromagnetic radiation, the quantum theory of atoms and molecules. |
| Fundamentals of molecular spectroscopy, division of spectroscopic methods, types of spectra. |
| Parameters characterizing spectral bands - theoretical definitions and practical aspects, factors determining the shape of spectral bands. |
| Infrared spectroscopy including reflection techniques (total internal reflection - ATR method). |
| Raman spectroscopy. |
| UV-VIS Spectroscopy. |
| EPR Spectroscopy. |
| NMR Spectroscopy. |
| SERS and TERS techniques. |
| Applications of discussed spectroscopic techniques in chemistry, biology and medicine. |

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

|  |
| --- |
| Content outline |
| Acquainting with the principles of analysis of spectral spectra. |
| Familiarization with methods of safe work with biological objects. |
| Familiarization with the operation of particular types of spectrometers. |
| Sample preparation, measurement, spectrum recording. |
| Transformations of spectra and mathematical/statistical methods of their analysis. |
| Analysis of selected spectra. |

3.4. Methods of Instruction

*Lecture: distance learning*

*Classes: project work (research project, practical project), group work (problem solving, discussion)*

*Laboratory classes: designing and conducting experiments*

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 | *exam, colloquium, report* | lectures, classes, labs |
| LO\_02 | *exam, colloquium, report, observation during classes* | lectures, classes, labs |
| LO\_03 | *exam, observation during classes* | lectures, labs |
| LO\_04 | *exam, colloquium, report* | classes, labs |
| LO\_05 | *exam, colloquium, report, observation during classes* | classes, labs |
| LO\_06 | *colloquium, report, observation during classes* | classes, labs |
| LO\_07 | *colloquium, report, observation during classes* | classes, labs |
| LO\_08 | *report, observation during classes* | classes, labs |

4.2 Course assessment criteria

|  |
| --- |
| Attendance at classes, passing the exam, passing the final test, obtaining a positive grade for reports. |

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 teacher (consultation hours, examinations) | 5 |
| Non-contact hours - student's own work (preparation for classes or examinations, projects, etc.) | 60 |
| Total number of hours | 95 |
| Total number of ECTS credits | 5 |

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

6. Internships related to the course/module

|  |  |
| --- | --- |
| Number of hours | *not applicable* |
| Internship regulations and procedures | *not applicable* |

7. Instructional materials

|  |
| --- |
| Compulsory literature:   1. D. L. Pavia, G. M. Lampman, G. S. Kriz, J. R. Vyvyan “Introduction to spectroscopy”, Cengage Learning, 2013 2. P. Davidovits “Physics in Biology and Medicine”, Elsevier Academic Press, 2019 |
| Complementary literature:   1. G. M. Barrow “Introduction to molecular spectroscopy”, McGraw-Hill Book Company, Inc., Tokyo, 1962 2. H. Haken, H. Ch. Wolf, “Molecular Physics and Elements of Quantum Chemistry: Introduction to Experiments and Theory”, Springer Berlin Heidelberg, 2014. |

Approved by the Head of the Department or an authorised person