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 | Fundamentals of metrology |
| 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 1, winter semester |
| Course type |  |
| Language of instruction | English |
| Coordinator | Dr Krzysztof Kucab |
| 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** |
| 1 |  |  |  | 30 |  |  |  |  | **4** |

1.2. Course delivery methods

x conducted in a traditional way

x involving distance education methods and techniques (in the case of an epidemic threat)

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

pass with a grade

2. Prerequisites

|  |
| --- |
| KNOWLEDGE OF CLASSICAL PHYSICS (BASICS) AND CALCULUS (BASICS) |

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

3.1. Course/Module objectives

|  |  |
| --- | --- |
| O1 | to familiarize students with the basics of modern metrology, in particular in the field of mechanical and electrical measurements and signal processing |
| O2 | to familiarize students with measurement tools |

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 | student knows the basic computational methods used to solve typical problems in the field of metrology. | K\_W05 |
| LO\_02 | student knows and understands the basic aspects of the construction of instruments used in metrology, understands the importance of periodic calibration for correct measurements. | K\_W07 |
| LO\_03 | student is able to analyze measurements taking into account measurement uncertainties. | K\_U01 |
| LO\_04 | student is able to prepare a report based on the measurements made. | K\_U05, K\_U11 |
| LO\_05 | student is able to plan and perform simple experimental tests or observations in the field of metrology and analyze the results. | K\_U06 |
| LO\_06 | student is able to cooperate and work in a group in order to correctly perform the measurement. | K\_U14 |
| LO\_07 | student is aware of his own limitations and knows when to ask the experts | K\_K01 |

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

1. Lectures

|  |
| --- |
| Content outline |
| Introduction. Basic concepts of metrology. Systems of units. |
| Statistical analysis of measurement uncertainties. Histogram. Normal distribution. Arithmetic mean and standard deviation. Least squares method. |
| Type A evaluation of standard uncertainty. |
| Type B evaluation of standard uncertainty. |
| Indirect measurements in the case of type A and B uncertainties. |
| Simple electronic circuits. |
| Measuring tools. Processing of measurement signals. Typical electrical measuring instruments. Binary number system. Transducers. A/C and D/A converters. Voltmeters and digital multimeters. Digital oscilloscopes. |
| An example of a measurement process cycle: preparation, measurement. Preparation of the report. |

1. Classes (solving tasks related to the topics discussed in the lectures)

|  |
| --- |
| Content outline (selected exercises) |
| Determination of the density of a body with regular shape using a ruler and a micrometer |
| DC current and voltage measurement. Determining the accuracy class of an analog electric meter. |
| DC current and voltage measurement. Use of digital meters. |
| Basic oscilloscope measurements. Analog oscilloscope. |
| Basic oscilloscope measurements. Digital oscilloscope. |
| RMS value measurements with analog and digital meters. |
| Adjustable voltage divider. Output voltage measurement. |
| Frequency measurements using Lissajous curves. |

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*

1. Lecture

2. Multimedia presentation

3. performing laboratory exercises

4. Discussion

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 | observation during classes, report | lectures, lab. classes |
| LO-o2 | observation during classes, report | lectures, lab. classes |
| LO-o3 | observation during classes, report | lab. classes |
| LO-o4 | observation during classes, report | lab. classes |
| LO-o5 | observation during classes, report | lab. classes |
| LO-o6 | observation during classes | lab. classes |
| LO-07 | observation during classes | lab. classes |

4.2 Course assessment criteria

|  |
| --- |
| 1. Oral response (exercises)  2. Student’s activity in solving tasks exercises:  a. Low 2  b. Average 3  c. High 4  d. Very high 5 |

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, projects.) | 50 |
| 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

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

7. Instructional materials

|  |
| --- |
| Compulsory literature:  1. J.R. Taylor, *Introduction to Error Analysis, Second Edition: The Study of Uncertainties in Physical Measurements*.  2. Ch.K. Alexander, M.N.O. Sadiku, *Fundamentals of electric circuits*. |
| Complementary literature:  1. JCGM 100:2008. GUM 1995 with minor corrections. Evaluation of measurement data — Guide to the expression of uncertainty in measurement. |

Approved by the Head of the Department or an authorized person