Appendix No. 1.5 to the Resolution No. 61/2025
of the Rector of the University of Rzeszów

SYLLABUS

REGARDING THE QUALIFICATION CYCLE FROM 2026-2027TO 2027-2028
ACADEMIC YEAR 2026-2027

1. BASIC COURSE/MODULE INFORMATION

Course/Module title	**Laboratory of Instrumental Analyses**
Course/Module code *	
Faculty (name of the unit offering the field of study)	Faculty of Technology and Life Sciences
Name of the unit running the course	Institute of Agricultural Sciences, Environmental Protection and Management, Department of Soil Science, Environmental Chemistry, and Hydrology
Field of study	Agriculture
Qualification level	Second-cycle (Master's level)
Profile	General academic
Study mode	Full time
Year and semester of studies	Year 1, Semester 1
Course type	Basic
Language of instruction	English
Coordinator	Edmund Hajduk, DSc Eng., Prof. UR
Course instructor	Edmund Hajduk, DSc Eng., Prof. UR

* - as agreed at the faculty

1.1. Learning format – number of hours and ECTS credits

Semester (no.)	Lectures	Classes	Laboratories	Seminars	Practical classes	Internships	others	**ECTS credits**
1			30					3

1.2. Course delivery methods

- ☒ traditional classes
- ☐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 chemistry and physics.

3. OBJECTIVES, LEARNING OUTCOMES, COURSE CONTENT, AND INSTRUCTIONAL METHODS

3.1. Course/Module objectives

O1	Imparting knowledge regarding the fundamentals of sample preparation for analysis
O2	Familiarizing the student with instrumental analysis methods, with an emphasis on their application in agriculture
O3	Acquiring the skills to properly use selected instrumental analysis methods, process the obtained results, and interpret them

3.2. COURSE/MODULE LEARNING OUTCOMES

Learning Outcome	The description of the learning outcome defined for the course/module	Relation to the degree programme outcomes
LO_01	The student knows the principles of sample collection for laboratory analysis, the application of appropriate instrumental analysis methods to perform determinations on soil, plant, and animal material, and the processing and interpretation of the obtained results	K_W03
LO_02	is able to interpret the obtained results by checking the levels of determined constituents against applicable standards and comparing them with current subject literature	K_U01
LO_03	based on acquired skills, is able to apply appropriate instrumental analysis methods to determine constituents in the material that are in demand or may have a negative impact on the environment	K_U04, K_U06
LO_04	is able to prepare a report based on the obtained results and conduct a discussion grounded in the conclusions drawn	K_U05
LO_05	during laboratory work, is able to work both in a team and independently, while effectively planning the work	K_U06, K_U07
LO_06	adheres to generally accepted recommendations and standards in chemical laboratories as well as expert opinions	K_K02

3.3. Course content

A. Laboratories

Content outline:
Health and safety in chemical laboratories. Basic concepts in analytical chemistry, analytical techniques, and classification of instrumental analysis methods. Data processing, error analysis, and method validation.
Principles of environmental sampling. Sample preparation methods: extraction, mineralization, and speciation analysis.
Gravimetric methods – determination of absolute dry mass.

Automation of traditional analytical methods, illustrated by the determination of total nitrogen in environmental samples using an automated Kjeldahl analyzer.
Introduction to electroanalytical methods. Physical and chemical principles. Coulometric, electrogravimetric, polarographic, potentiometric, and conductometric methods. Determination of solution pH and conductivity. Applications of electroanalytical methods in environmental analysis (examples).
Use of optical methods in instrumental analysis: applications in agricultural research (examples). Polarimetric and refractometric methods, illustrated by sugar content analysis. UV-Vis spectrophotometry and its use in agricultural and environmental analysis. Practical application of these methods in agrochemical research.
Atomic absorption and its application in the analysis of macro-elements, micro-elements, and trace elements. Atomization methods. Determination of the content of a selected metal in environmental samples.
Emission spectrophotometry methods. Flame photometry and ICP-AES in trace analysis.
Theoretical principles of chromatography. Gas chromatography. Detectors in gas chromatography. Applications of gas chromatography in environmental analysis.
Liquid chromatography and its variants. Columns and detectors in liquid chromatography. Selection of a chromatographic system for the analysis of selected xenobiotics. TLC and paper chromatography, illustrated by the separation of dyes using planar chromatography.
Mass spectrometry and its applications. Coupling mass spectrometry with chromatographic techniques to enhance the sensitivity and selectivity of analytical methods.
Other analytical techniques used in environmental analysis: flow analysis, elemental analysis.

3.4. Methods of Instruction

Laboratory exercises: multimedia presentation, laboratory work, analysis of results with discussion, analysis of source materials.

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	test	lab. exercises
LO_02	test, report	lab. exercises
LO_03	test, report, observation during classes	lab. exercises
LO_04	observation during classes, report	lab. exercises
LO_05	observation during classes, report	lab. exercises
LO_06	observation during classes, report	lab. exercises

4.2 Course assessment criteria

Attendance at tutorials; interim tests on tutorial material; grades for reports.

*A passing grade on a test is determined by the number of points obtained (>50% of the maximum score): satisfactory >50%, satisfactory plus >60%, good >70%, good plus >80%, very good >90%.

TO PASS THE COURSE, ALL SPECIFIED LEARNING OUTCOMES MUST BE ACHIEVED.

5. Total student workload needed to achieve the intended learning outcomes – number of hours and ECTS credits

Activity	Number of hours
Course hours	30
Other contact hours involving the teacher (consultation hours, examinations)	10
Non-contact hours - student's own work (preparation for classes or examinations, projects, etc.)	40
Total number of hours	80
Total number of ECTS credits	3

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

6. Internships related to the course/module

Number of hours	-
Internship regulations and procedures	-

7. Instructional materials

Compulsory literature: materials provided by the teacher and online resources on the topics covered
Complementary literature: online resources on the topics covered

Approved by the Head of the Department or an authorised person