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 TO 2029
ACADEMIC YEAR 2026/2027.

1. BASIC COURSE/MODULE INFORMATION

Course/Module title	Introduction to Logic and Set Theory
Course/Module code *	
Faculty (name of the unit offering the field of study)	Faculty of Exact and Technical Sciences
Name of the unit running the course	Institute of Mathematics
Field of study	Mathematics
Qualification level	First-cycle studies (Bachelor's)
Profile	General academic
Study mode	Full-time
Year and semester of studies	Year 1, Semester 1
Course type	Major subject
Language of instruction	English
Coordinator	Jacek Chudziak, PhD, DSc
Course instructor	Jacek Chudziak, PhD, DSc

* - 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	30						6

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)

Lecture – exam, classes – pass with a grade

2. PREREQUISITES

The knowledge of elementary mathematics at the level of secondary school.

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

3.1. Course/Module objectives

O1	Familiarization students with the basic concepts of mathematical logic and set theory.
O2	Developing skills in using propositional logic, set theory, and quantifiers.
O3	Developing the ability to use relational calculus (functions, equivalence relations, and order relations).

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 student knows and understands basic concepts in the field of propositional calculus, quantifier calculus, and set theory.	K_W01, K_W03
LO_02	The student knows and understands basic properties and types of relations as well as basic properties of functions. Knows and understands basic concepts of cardinality theory.	K_W01, K_W04
LO_03	The student knows and understands theorems in the field of logic and set theory and the techniques for proving them; perceives the essence of assumptions in the proofs of these theorems.	K_W02, K_W04
LO_04	The student is able to apply the laws of propositional and quantifier calculus to prove properties of operations.	K_U02, K_U03
LO_05	The student is able to use the language of set theory, verify properties of relations, determine images and pre-images of sets through functions, and justify the equinumerosity of sets.	K_U01, K_U03
LO_06	The student is able to determine distinguished elements in ordered sets.	K_U02, K_U03
LO_07	The student is ready to critically evaluate the acquired content in logic and set theory and recognize the need for improving their own competences in this field.	K_K01

LO_08	The student is ready to present a critical attitude towards received content regarding its logical justification.	K_K02
LO_09	The student is ready to ask questions aimed at understanding a studied problem in terms of applying propositional and quantifier calculus and relational calculus in solving theoretical and practical mathematical issues.	K_K03

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

A. Lectures

Content outline
Propositional calculus. Logical connectives. Tautologies of propositional calculus. Rules of inference. Examples of applications of tautologies and inference rules in proving theorems.
Predicate calculus. The notion of a propositional function. Quantifiers. Tautologies of quantifier calculus and rules of inference, examples of applications.
Algebra of sets. Primitive notions. Empty set, finite sets. Inclusion of sets. Set operations: union, intersection, difference. Universal set and complement of a set. Defining sets by propositional functions.
Indexed families of sets. Definition and examples. Union and intersection of indexed families, basic properties.
Relations. Ordered pair. Cartesian product of sets. Binary and n-ary relations. Domain and codomain of a relation. Union, intersection, and composition of relations. Inverse relation. Properties of relations: reflexivity, symmetry, antisymmetry, asymmetry, transitivity, connectedness.
Functions. Function as a single-valued relation. Injective, surjective, and bijective functions. Inverse function. Composition of functions. Image and preimage of a set under a function.
Equivalence relations. Definition of an equivalence relation. Equivalence class, abstraction principle, partition of a set into equivalence classes.
Ordered sets. Order relations. Ordered sets. Distinguished elements (greatest, least, maximal, minimal, etc.). Linearly ordered sets.
Cardinality theory. Equinumerosity of sets. Cardinal numbers. Countable sets and basic theorems. Uncountable sets. Sets of the cardinality of the continuum.

B. Classes, laboratories, seminars, practical classes

Content outline

Propositional calculus. Logical connectives. Tautologies of propositional calculus. Rules of inference. Examples of applications of tautologies and inference rules in proving theorems.
Predicate calculus. The notion of a propositional function. Quantifiers. Tautologies of quantifier calculus and rules of inference, examples of applications.
Algebra of sets. Primitive notions. Empty set, finite sets. Inclusion of sets. Set operations: union, intersection, difference. Universal set and complement of a set. Defining sets by propositional functions.
Indexed families of sets. Definition and examples. Union and intersection of indexed families, basic properties.
Relations. Ordered pair. Cartesian product of sets. Binary and n-ary relations. Domain and codomain of a relation. Union, intersection, and composition of relations. Inverse relation. Properties of relations: reflexivity, symmetry, antisymmetry, asymmetry, transitivity, connectedness.
Functions. Function as a single-valued relation. Injective, surjective, and bijective functions. Inverse function. Composition of functions. Image and preimage of a set under a function.
Equivalence relations. Definition of an equivalence relation. Equivalence class, abstraction principle, partition of a set into equivalence classes.
Cardinality theory. Equinumerosity of sets. Cardinal numbers. Countable sets and basic theorems. Uncountable sets. Sets of the cardinality of the continuum.

3.4. Methods of Instruction

Lecture: lecture supported by a multimedia presentation (possibility of using MS Teams).
Classes: problem solving, 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, exam, test, discussion	lectures, classes
LO-02	observation during classes, exam, test, discussion	lectures, classes
LO-03	observation during classes, discussion	lectures, classes
LO-04	observation during classes, exam, test, discussion	lectures, classes
LO-05	observation during classes, exam, test, discussion	lectures, classes
LO-06	observation during classes, exam	lectures, classes
LO-07	observation during classes	lectures, classes

LO-08	observation during classes	lectures, classes
LO-09	observation during classes	lectures, classes

4.2 Course assessment criteria

Classes: passing based on tests and activity during classes. A minimum of 50% of points from each test is required to pass. Final grade according to the scale: below 50% – fail, [50–60%) – satisfactory, [60–70%) – satisfactory plus, [70–80%) – good, [80–90%) – good plus, [90–100%] – very good. Class activity may increase the final grade by up to half a grade. Exam: a minimum of 50% is required to pass. Final grade according to the scale: below 50% – fail, [50–60%) – satisfactory, [60–70%) – satisfactory plus, [70–80%) – good, [80–90%) – good plus, [90–100%] – very good.

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

Activity	Number of hours
Course hours	60
Other contact hours involving the teacher (consultation hours, examinations)	5
Non-contact hours - student's own work (preparation for classes or examinations, projects, etc.)	85
Total number of hours	150
Total number of ECTS credits	6

* 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. Kossak, R., *Mathematical Logic: On Numbers, Sets, Structures, and Symmetry*. 2nd ed., Springer, Cham, 2024. 2. O'Leary, M. L., *A First Course in Mathematical Logic and Set Theory*. John Wiley & Sons, Hoboken, NJ, 2016.
Complementary literature: 1. Ferrari Ruffino, F., *Naive Set Theory: A Rigorous Approach*. CRC Press, Boca Raton, 2025. 2. Srivastava, S. M., *An Introduction to Naïve Set Theory and Its Applications*. Springer, Singapore, 2024.

Approved by the Head of the Department or an authorised person