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	Calculus 1
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	Svetlana Mincheva-Kamińska, PhD
Course instructor	Svetlana Mincheva-Kamińska, PhD

* - 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	60	60						12

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 axiomatics, construction and properties of the set of real numbers, with the concept of infimum and supremum and with the concept of a function and the basic properties of functions.
O2	Familiarization students with definitions, examples and theorems concerning numerical sequences as well as with methods of testing the convergence of numerical sequences.
O3	Familiarization students with the basics of the theory of real functions of one variable - with limits of functions, with continuity and differentiability of functions, and with applications of the derivative of a function to examine the course of variation of a function.

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 the axiomatics of the set of real numbers and the consequences of the supremum axiom.	K_W01, K_W02, K_W03, K_W04
LO_02	The student is able to determine the extrema (infima and suprema) of subsets of the set of real numbers, examine the basic properties of functions, compose functions and determine inverse functions.	K_U01, K_U02, K_U04

LO_03	The student knows and understands: basic concepts concerning numerical sequences and basic theorems concerning convergence of sequences and their proofs.	K_W02, K_W03, K_W04
LO_04	The student is able to prove the convergence of elementary sequences and calculate their limits.	K_U01, K_U02, K_U04
LO_05	The student knows and understands: the definition of the limit of a function and basic theorems concerning the limit of a function; definitions of function continuity and basic theorems concerning function continuity.	K_W01, K_W02, K_W03, K_W04
LO_06	The student is able to calculate the limits of elementary functions and prove the continuity of elementary functions.	K_U01, K_U02
LO_07	The student knows and understands: the concept of the derivative of a function and properties of differentiable functions; mean value theorems and their proofs, and consequences.	K_W01, K_W02, K_W03, K_W04
LO_08	The student knows how to calculate derivatives of elementary functions. They are able to apply differential calculus to examine the course of variation of a function.	K_U01, K_U02, K_U04, K_U05
LO_09	The student is able to critically evaluate the acquired knowledge concerning basic issues of differential calculus and is ready to apply it in various fields of life and knowledge.	K_K02, K_K03
LO_10	The student recognizes the limitations of their own knowledge; understands the need for further learning. Independently searches literature and the Internet for information regarding differential calculus and seeks expert advice when necessary.	K_K01, K_K02, K_K03

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

A. Lectures

Content outline	
Set of real numbers (4 hours)	Axiomatics and construction of the set ***R*** of all real numbers. Infima and suprema of bounded subsets of the set ***R***.

Content outline	
Functions of one real variable (4 hours)	Definition. Domain, codomain, and graph of a function. Basic properties of functions. Elementary functions. Composite functions. Inverse functions. Examples.
Numerical sequences (12 hours)	Definitions and properties of convergent, bounded and monotonic sequences. Cauchy sequences. Arithmetic properties of the limit of a sequence. The number e as a limit of a numerical sequence. Monotonicity of the limit. Improper limits and indeterminate forms. Subsequences. Bolzano-Weierstrass theorem. Partial limits of sequences.
Limits of functions (8 hours)	Limit of a function at a point and at infinity (Heine's and Cauchy's definitions). One-sided limits. Properties of limits of functions at a point. Asymptotes of a function graph. Examples.
Continuity of functions (12 hours)	Continuity of a function at a point and on a set. Discontinuities. Continuity of elementary functions. Pointwise continuity and uniform continuity of a function. Properties of continuous functions on a compact set and on a compact interval.
Differentiability of functions (12 hours)	Definition of the derivative of a function at a point. Geometric and physical interpretations of the derivative. Theorems on derivatives and differentiation rules. Continuity vs. differentiability. Derivatives of elementary functions. Mean value theorems (Cauchy's, Lagrange's, Rolle's) and their applications. L'Hôpital's rules. Derivative as a function. Higher-order derivatives, Taylor's formula. Applications.
Examination of the course of variation of a function (8 hours)	Monotonicity of a function. Local extrema of a function, greatest and least value of a function. Convexity and concavity of a function. Applications.

B. Classes, laboratories, seminars, practical classes

Content outline	
Set of real numbers (6 hours)	Peano axioms for natural numbers; principle of mathematical induction; extrema (infima and suprema) of subsets of the set of real numbers; properties of absolute value.
Functions of one real variable (4 hours)	Domain of a function, basic properties of functions; elementary and composite functions; power, exponential and logarithmic functions; trigonometric and inverse trigonometric (cyclometric) functions.
Numerical sequences (12 hours)	Definition and examples of determining limits of numerical sequences; arithmetic properties of sequence limits; Squeeze (Sandich) theorem for sequences, theorems on monotonic and bounded sequences; sequence definition of the number *e*; partial limits.
Limits of functions (8 hours)	Definitions and determination of function limits at a point and at infinity; asymptotes of a function graph.
Continuity of functions (6 hours)	Continuity of a function at a point; one-sided continuity; points of discontinuity.
Differentiability of functions (12 hours)	Derivative of a function at a point; calculation of derivatives using differentiation rules; higher-order derivatives; Taylor's formula. Indeterminate forms, L'Hôpital's rule and its applications.
Examination of the course of variation of a function (8 hours)	Monotonicity of a function; local extrema of a function, least and greatest value of a function, intervals of convexity and concavity of a function, inflection points; plotting a function graph.

3.4. Methods of Instruction

Lecture – using the traditional method;
Classes – using the traditional method.

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 – LO_10	Observation and dialogue with students during classes, Student activity in class, Oral statements of students, Colloquium, Exam	lecture, classes

4.2 Course assessment criteria

Classes: passing on the basis of colloquia and activity in classes.

The condition for obtaining the completion of the classes is to obtain at least 50% of points from each colloquium. Being active during classes can increase the grade by a maximum of half a grade.

The final grade is determined according to the scale:

00 - 49 % of points – fail (2.0);

50 – 59 % of points – satisfactory (3.0); 60 – 69 % of points – satisfactory plus (3.5);

70 – 79 % of points – good (4.0); 80 – 89 % of points – good plus (4.5);

90 – 100 % of points – very good (5.5).

Lecture: written exam.

Assessment criteria: (percentage share in mastering knowledge – assessment)

00-49 % of points – fail (2.0);

50 – 59 % of points - satisfactory (3.0); 60 – 69 % of points - satisfactory plus (3.5);

70 – 79% pts.- good (4.0); 80 – 89% points – good plus (4.5);

90 – 100% points - very good (5.0).

The final grade from the exam is determined on the basis of a written exam and an interview with the student.

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

Activity	Number of hours
Course hours	120 (60 lectures + 60 classes)
Other contact hours involving the teacher (consultation hours, examinations)	12 (Consultation 8; Exam 4)
Non-contact hours - student's own work (preparation for classes or examinations, projects, etc.)	168 (Class Preparation 120; Exam Preparation 48)
Total number of hours	300
Total number of ECTS credits	12

* 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. Angus E.. Taylor, *General Theory of Functions and Integration*, Dover Publications, New York,1986
2. Paul Dawkins, *CALCULUS I,* http://tutorial.math.lamar.edu
3. Raz Kupferman, *Lecture notes of Calculus,* The Hebrew University, 2013

Complementary literature:

1. Basic Calculus Teachers Guide.pdf
2. Seongjai Kim, *Calculus Lectures,* Mississippi State University, 2024 **CALCULUS-LECTURES.PDF**

Approved by the Head of the Department or an authorised person