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 2028/2029

1. BASIC COURSE/MODULE INFORMATION

Course/Module title	Monographic Lecture
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
Profile	General academic
Study mode	Full-time
Year and semester of studies	Year 3, Semester 6
Course type	(elective)
Language of instruction	English
Coordinator	Ewa Rak, PhD
Course instructor	Ewa Rak, PhD; Anna Król, 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**
6	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)
Classes – pass with a grade, lectures – exam

2. PREREQUISITES

Basic knowledge of mathematical analysis (functions of several variables), probability theory, and logic.

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

3.1. Course/Module objectives

O1	Familiarize students with the theoretical foundations, axioms, and properties of various classes of aggregation functions.
O2	Introduce the basic concepts of fuzzy set theory, including membership functions and fuzzy logic operations.
O3	Present practical applications of aggregation tools in fields such as decision support systems and data fusion.

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 definitions and properties concerning aggregation functions, fuzzy sets, and their basic operations (t-norms, t-conorms).	K_W01.
LO_02	The student has knowledge concerning proof methods and computational techniques related to aggregation operators, fuzzy logic, and fuzzy relations.	K_W02
LO_03	The student is able to formulate and prove selected theorems regarding aggregation properties and illustrate them with examples; knows the relationship between different classes of operators (e.g., means and integrals).	K_U01.
LO_04	The student is able to formulate problems serving a better understanding of concepts concerning fuzzy set theory and aggregation functions and attempt to solve them using analytical or numerical methods.	K_U02.
LO_05	The student knows the limitations of their own knowledge and understands the need for further education in the field of modern mathematical tools.	K_K01
LO_06	The student is able to formulate opinions on content concerning aggregation functions and fuzzy sets; independently searches for information in the literature and applies it properly.	K_K02

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

A. Lectures

Content outline
Introduction to fuzzy sets: Membership functions, α-cuts, and the extension principle.
Basic operations on fuzzy sets: Triangular norms (t-norms), t-conorms, and fuzzy negations.
Axiomatic definition of aggregation functions: Monotonicity, boundary conditions, and symmetry.
Averaging aggregation functions: Quasi-arithmetic means, OWA (Ordered Weighted Averaging) operators.
Conjunctive and disjunctive operators: Properties and examples.
Integrals as aggregation tools: Introduction to the Choquet and Sugeno integrals.
Practical applications: Multi-criteria decision-making (MCDM) and data processing.

B. Classes, laboratories, seminars, practical classes

Content outline
Performing operations on fuzzy sets and verifying their properties.
Calculating values of various aggregation operators for given data sets.
Analyzing the properties of specific t-norms and t-conorms.
Application of OWA operators and weighted means in decision scenarios.
Computing Choquet and Sugeno integrals for simple discrete cases.

3.4. Methods of Instruction

Lecture: lecture with a multimedia presentation. Exercises: solving tasks, group work, 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	WRITTEN TEST, EXAM	CLASSES, LECTURE
LO-02	WRITTEN TEST, EXAM	CLASSES, LECTURE
LO-03	WRITTEN TEST, EXAM	CLASSES, LECTURE
LO-04	OBSERVATION AND DIALOGUE WITH STUDENTS DURING CLASSES	CLASSES, LECTURE
LO-05	OBSERVATION AND DIALOGUE WITH STUDENTS DURING CLASSES	CLASSES, LECTURE
LO-06	OBSERVATION AND DIALOGUE WITH STUDENTS DURING CLASSES	CLASSES, LECTURE

4.2 Course assessment criteria

Passing exercises takes place on the basis of quizzes and activity during classes. The condition for passing the exercises is obtaining at least 50% of points from each quiz. The final grade is then determined according to the scale: below 50% pts. – fail, [50 – 60%) pts. – satisfactory, [60 – 70%) pts. – satisfactory plus, [70 – 80%) pts. – good, [80 – 90%) pts. – good plus, [90– 100%] pts. – very good. Activity during exercises can raise the grade by at most half a degree.

Passing the lecture takes place on the basis of written tests verifying the mastery of the lecture material. The condition for passing the lecture is obtaining at least 50% of points from the written tests.

Exam. The condition for taking the exam is obtaining a pass from the lecture and exercises. The exam is in written form and includes a task part and a theoretical part. The condition for passing the exam is obtaining at least 50% of points from it. The final grade is then determined according to the scale: below 50% pts. – fail, [50 – 60%) pts. – satisfactory, [60 – 70%) pts. – satisfactory plus, [70 – 80%) pts. – good, [80 – 90%) pts. – good plus, [90– 100%] pts. – very good.
A student who fails the exam has the right to a retake exam written on the rules of the exam in the basic session.

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)	4
Non-contact hours - student's own work (preparation for classes or examinations, projects, etc.)	86
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	-
Internship regulations and procedures	-

7. Instructional materials

Compulsory literature: 1. Grabisch, M., Marichal, J.-L., Mesiar, R., & Pap, E. (2009). Aggregation Functions. Cambridge University Press. 2. Klir, G. J., & Yuan, B. (1995). Fuzzy Sets and Fuzzy Logic: Theory and Applications. Prentice Hall.
Complementary literature: 1. Calvo, T., Mayor, G., & Mesiar, R. (Eds.). (2002). Aggregation Operators: New Trends and Applications. Physica-Verlag. 2. Beliakov, G., Pradera, A., & Calvo, T. (2007). Aggregation Functions: A Guide for Practitioners. Springer.

Approved by the Head of the Department or an authorised person