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 2027/2028

1. BASIC COURSE/MODULE INFORMATION

Course/Module title	Optimization 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 2, Semester 4
Course type	Specialisation course
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**
4	30		30					5

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 (laboratory) – pass with a grade, lecture – exam

2. PREREQUISITES

Knowledge of mathematical analysis (extrema of multivariable functions) and linear algebra.

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

3.1. Course/Module objectives

C1	Introducing students to methods used in operations research, including assumptions, conditions, and limitations of their application.
C2	Demonstrating the cognitive value of the methods and their application in decision-making processes.
C3	Developing students' ability to solve selected classes of problems using tools such as solvers.

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 has basic knowledge of decision model construction.	K_W01, K_W02, K_W07
LO_02	The student is able to apply algorithms to solve linear programming problems.	K_U16, K_U04
LO_03	The student is able to determine optimal strategies in games.	K_U16, K_U04
LO_04	The student is able to solve basic nonlinear programming problems.	K_U16, K_U04
LO_05	The student is ready to acknowledge limitations of their knowledge and understands the need for further education and practical application of acquired knowledge.	K_K02, K_K03

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

A. **Lectures**

Content outline
Decision process. Linear programming. Production planning problem, blending problem, diet problem. Sensitivity analysis. Simplex algorithm. Duality in linear programming. Fractional programming. Hungarian algorithm.
Transportation problems. Classical transportation problem, production location problem, empty mileage problem. Transportation algorithm.
Queueing theory.
Data Manipulation Language (DML): commands and syntax. Transaction concept and management. Data integrity and constraint handling. Indexes and database optimisation.
Decision games. Zero-sum games, games against nature, cooperative games.
Network programming.
Nonlinear programming.

B. Classes, laboratories, seminars, practical classes

Content outline
Decision process. Linear programming. Production planning problem, blending problem, diet problem. Sensitivity analysis. Simplex algorithm. Duality in linear programming. Fractional programming. Hungarian algorithm.
Transportation problems. Classical transportation problem, production location problem, empty mileage problem. Transportation algorithm.
Queueing theory.
Data Manipulation Language (DML): commands and syntax. Transaction concept and management. Data integrity and constraint handling. Indexes and database optimisation.
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3.4. Methods of Instruction

Laboratory classes: problem solving, discussion, group work.
Lectures: problem-based lecture / multimedia presentation.

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	laboratory
LO-02	test	laboratory
LO-03	test	laboratory
LO-04	test	laboratory
LO-05	Observation during classes	lecture, laboratory

4.2 Course assessment criteria

Continuous assessment during classes. Final grade reflects achievement of learning outcomes.
Lecture is passed based on a test.
Laboratory classes are passed based on a written test and activity during classes.
Grading scale:
50–59% – satisfactory (3.0)
60–69% – satisfactory plus (3.5)
70–79% – good (4.0)
80–89% – good plus (4.5)
90–100% – very good (5.0)

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.)	60
Total number of hours	125
Total number of ECTS credits	5

* 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. Bertsekas, D. P., *Convex Optimization Theory*. Athena Scientific, Belmont, Massachusetts, 2009. 2. Boyd, S., Vandenberghe, L., *Convex Optimization*. Cambridge University Press, Cambridge, 2004.
Complementary literature: 1. Jahn, J., *Introduction to the Theory of Nonlinear Optimization* 4th ed. Springer, Cham, 2020. 2. Rockafellar, R. T., *Convex Analysis.* Princeton University Press, Princeton, 1970.

Approved by the Head of the Department or an authorised person