Subject card

Subject name and code	Optimization Theory II, PG_00208871						
Field of study	Mathematics						
Date of commencement of studies	October 2025			Academic year of realisation of subject		2026/2027	
Education level	Master’s studies			Subject group		Optional subject group	
Mode of study	full-time studies			Mode of delivery		at the university	
Year of study	2			Language of instruction		Polish	
Semester of study	3			ECTS credits		6.0	
Learning profile	academic			Assessment form		exam	
Conducting unit	Institute of Mathematics -> Faculty of Mathematics, Physics and Informatics -> Rector						
Name and surname of lecturer (lecturers)	Subject supervisor		dr Monika Wrzosek				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	30.0	0.0	0.0	0.0	60
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours	Self-study		SUM
	Number of study hours	60		10.0	80.0		150
Subject objectives	To introduce students to the theoretical foundations and main applications of optimization theory.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[MATMU2_K06] is ready to formulate opinions on basic mathematical issues	The student is able to formulate opinions on basic optimization problems.	[SK1] oral statement/conversation/ discussion
	[MATMU2_W02] knows and understands well the role and importance of the construction of mathematical reasoning	The student knows and understands the proofs of theorems and understands the role of reasoning constructions in optimization problems and their applications.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion
	[MATMU2_W03] knows and understands in-depth a selected field of theoretical or applied mathematics and is able to understand the formulations of issues in this field that are still at the research stage and knows the connections of issues in this field with other areas of mathematics	The student knows and understands the proofs of theorems and understands the role of reasoning constructions in optimization problems and their applications.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion
	[MATMU2_U07] is able to define his/her interests and develop them; in particular, is able to establish contact with specialists in his/her field, e.g. understand their lectures intended for young mathematicians	The student is able to develop his/ her interests in order to be able to construct and solve optimization problems.	[SU1] oral statement/conversation/ discussion [SU8] observation of student's independent or team work
	[MATMU2_U04] is able, at an advanced level and including modern mathematics, to apply and present, orally and in writing, methods of at least one selected branch of mathematics	The student is able to apply optimization theory methods at an advanced level.	[SU4] test/exam - oral or written
	[MATMU2_U06] is able to apply methods and examples from a selected field of mathematics in related fields	The student is able to construct and solve models of optimization problems in related fields of science.	[SU4] test/exam - oral or written
	[MATMU2_U01] can construct mathematical reasoning: prove theorems and refute hypotheses through construction and selection of counterexamples	The student is able to prove selected theorems in the theory of optimization and refute hypotheses by selecting counterexamples	[SU1] oral statement/conversation/ discussion [SU4] test/exam - oral or written
	[MATMU2_K04] is ready to understand and appreciate the importance of intellectual honesty in one's own and other people's actions; ethical conduct	The student understands and appreciates the importance of intellectual integrity and ethical conduct	[SK8] observation of student's independent or team work
	[MATMU2_U03] can understand mathematical texts of various types from selected fields of mathematics	The student is able to prove selected theorems in the theory of optimization, construct and solve models of optimization problems.	[SU4] test/exam - oral or written
	[MATMU2_K02] is ready to precisely formulate questions to deepen his/her understanding of a given topic or find missing elements of reasoning	The student is ready to formulate questions aimed at deepening the understanding of a given topic.	[SK1] oral statement/conversation/ discussion [SK8] observation of student's independent or team work
	[MATMU2_K05] is ready to independently search for information in literature, also in foreign languages	The student is ready to search for information in scientific studies.	[SK8] observation of student's independent or team work
	[MATMU2_U05] can perform proofs in a selected field and, if necessary, also use tools from other areas of mathematics	The student is able to construct and solve selected optimization problems using tools from various branches of mathematics.	[SU1] oral statement/conversation/ discussion [SU4] test/exam - oral or written
	[MATMU2_W01] knows and understands in-depth the theory of selected areas of mathematics	The student knows and understands the classes of optimization problems, their applications and methods of solving, as well as the problems of approximation and optimization in normalized spaces and in Hilbert spaces.	[SW4] test/exam - oral or written
	[MATMU2_K01] is willing to acknowledge the limitations of his or her own knowledge and is willing to pursue further education	The student understands the limitations of their own knowledge and the need for lifelong learning	[SK8] observation of student's independent or team work

Subject contents	1. Uniform approximation of continuous functions on compact sets. 2. Characterization of the best approximation. Remez algorithm. 3. Splines and their applications in optimal approximation of linear functionals. 4. Global theory of conditional optimization. Duality theorems. 5. Generalized Lagrange multipliers. Iterative methods of optimization. 6. The method of steepest descent. Penalty function.
Prerequisites and co-requisites	Optimization Theory I

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
tests	51.0%	50.0%
observation of the student's attitude	51.0%	0.0%
egzam	51.0%	50.0%

Recommended reading

Basic literature	• D. G. Luenberger, *Teoria optymalizacji*. BNI,1974. • E. Pollak, *Metody obliczeniowe optymalizacji*. MIR, 1974. • M. M. Syslo, N. Deo, J. S. Kowalik, *Algorytmy optymalizacji dyskretnej*. PWN, 1995. • I. Nykowski, Z. Galas, *Zbiór zadań z programowania matematycznego I II* PWN 1986. • M. Brdyś, A. Ruszczyński, *Metody optymalizacji w zadaniach*, WNT 1985.
Supplementary literature	not included
eResources addresses	

Example issues/ example questions/ tasks being completed	not included
Work placement	Not applicable