

M143	Convex sets	L	P	S	ECTS
		2	0	1	5

Course objectives. The aim of the course is to introduce students with the basic concepts and results from the theory of convex sets which are the basis for many other courses such as Linear Programming, Convex Functions and Optimization Methods.

Prerequisites. Knowledge of the basic results from Real Analysis and Linear Algebra.

Course content.

1. Motivating examples from linear programming, theory of approximations and mathematical statistics.
2. Convex sets. Operations with convex sets. Convex hull. Cones. Polyhedrals. Polytopes. Simplices. Fourier-Motzkin elimination method. Decomposition of polyhedral. Farkas' lemma.
3. Topology of convex sets. Relative interior. Relative boundary. Carathéodory's theorem for convex hulls. Carathéodory's theorem for convex cones.
4. Fundamentals of linear programming.
5. Projection and separation. Projection onto convex sets. Linear least squares problems. Supporting and separating hyperplanes. Weak and strong separation.
6. Representation of convex sets. Extremal faces. Receptive and asymptotic cones. Minkowski's theorem for convex sets. More on polytopes and polyhedrals.

LEARNING OUTCOMES

No.	LEARNING OUTCOMES
1.	Learn the basic concepts and properties of convex sets.
2.	Well understanding of Carathéodory's theorems of convex sets and convex cones, topology of convex sets, theorems of projection to convex set, theorems of separation and representation of convex sets.
3.	Get acquainted with the concepts of linear programming, convex optimization and least squares methods.
4.	To acquire the prior knowledge required for many other courses such as Linear Programming, Convex Functions and Optimization Methods.

RELATING THE LEARNING OUTCOMES, ORGANIZATION OF THE EDUCATIONAL PROCESS AND ASSESSMENT OF THE LEARNING OUTCOMES

TEACHING ACTIVITY	ECTS	LEARNING OUTCOME **	STUDENT ACTIVITY*	EVALUATION METHOD	POINTS	
					min	max
Attending lectures and exercises	1	1-5	Lecture attendance, discussion, team work and independent work on given tasks	Attendance lists, tracking activities	0	30
Written exam (Mid-terms)	2	1-5			0	30
Final exam	2	1-5	Revision	Oral exam	0	40
TOTAL	5				0	100

Teaching methods and student assessment. Teaching will be organized through the lectures and seminars. Each student has to write a seminar paper during the semester and present it to

the all other students. Successfully completed seminar paper affects to the final grade from the course. The final exam consists of a written and oral part.

Can the course be taught in English: No

Basic literature:

1. D. Jukić, *Konveksni skupovi*, Odjel za matematiku, Osijek, 2021.

Recommended literature:

1. R. T. Rockafellar, *Convex Analysis*, Princeton University Press, New York, 1997.
2. J.-B. Hiriart-Urruty, C. Lemaréchal, *Convex Analysis and Minimization Algorithms I*, Springer, Berlin, 1993.
3. R. J. Vanderbei, *Linear Programming - Foundations and Extensions*, Kluwer Academic Publ., Boston, 2001.