M053	FIN, MR, IPM-elective Year 1	**Convex Functions**	L+P+S 1+1+0	ECTS 4

Course objectives. Systematize geometrical and analytical properties of convex sets and convex functions which are used in various areas of applied mathematics, in particular optimization.

Course prerequisites. Linear Algebra II, Functions of Several Variables.

Syllabus.

1. Convex sets. Definition of a convex set. Convex sets examples. Operations that preserve convexity. Generalized inequalities. Separation theorem. Dual sets.
2. Convex functions. Convex functions and characterizations. Convex functions defined on convex sets. Conjugate functions. Quasiconvex functions. Log-convex functions and log-concave functions. Convex functions and inequalities.

Expected learning outcomes.

After completing the course, students are expected to:

- differentiate between and give characteristic examples of convex and nonconvex sets, convex and concave functions;
- understand geometrical and analytical properties of convex sets and convex functions;
- use the properties of convex functions in various areas of applied mathematics, particulary optimization;
- understand and reproduce the correct mathematical proof of claim applying basic forms of mathematical and logical inference;
- use the mathematics literature from various sources and apply at least one programming tool for illustration of different examples.

Teaching methods and student assessment.

Lectures and exercises are obligatory. The final exam follows after completion of lectures and exercises and it consists of two parts, i.e., a written and an oral part. Acceptable mid-term exam scores replace the written examination. Students can do their homework or write a seminar paper and thus improve their final grade.

Can the course be taught in English: Yes.

Basic literature:

1. S. Boyd, L. Vandenbergher, Convex Optimization, Cambridge University Press, Cambridge, 2004.
2. M. Alić, G. Nogo, Optimizacija: Uvod u teoriju nužnih i dovoljnih uvjeta ekstrema, Odjel za matematiku, Sveučilište u Osijeku, Osijek, 2004.

Recommended literature:

1. D. Bertsimas, J. N. Tsitsiklis, Introduction to Linear Optimization, Athena Scientific, 1997.
2. M. S. Bazarra, H. D. Sherali, C. M. Shetty, Nonlinear Programming:Theory and Algorithms, 3rd Edition, Wiley, New Jersey, 2006.
3. J. M. *Borwein*, A. S. *Lewis*, Convex Analysis and Nonlinear Optimization, Springer-Verlag, New York, 2000.