MI004	Obligatory 3rd Semester	**Optimization Methods and Applications**	L	P	S	ECTS
			3	2	0	6

Course objective. The aim of the course is to introduce students to the modelling, solving and interpretation of real problems that can be reduced to an optimization problem or the problem of linear programming. Students will master the main methods of one-dimensional and multidimensional optimization with or without constraints. They will also analyse the numerical methods for solving linear programming problems as well as to present the appropriate geometrical interpretation. Special emphasis will be placed on familiarizing students with optimization problems that arise in applications. Computers will be used to implement the elaborated methods and to illustrate and test methods within the different examples of application. Students will connect mathematical and computer science knowledge.

Prerequisites. Undergraduate mathematics or computer science study programme.

Course content.

1. Introduction. Local and global minimum. Concavity and convexity of a functions and convex sets. Illustrative examples of optimization problems.
2. One-dimensional minimization. Golden section, parabola method and Brent's method. Newton method and its modifications. Application method one-dimensional minimization at practices.
3. Multidimensional minimization without constraints. Gradient method. Steepest descent method. Methods of Newton type. Minimization of non-differentiable function (Nelder-Mead method). Graphical presentations. Application of multidimensional minimization.
4. The problem of conditional minimization. Necessary and sufficient conditions for optimality. Gradient method with projection. Newton method with projection.
5. Linear programming. The definition of linear programming problems. Examples of linear programming problems. Graphical solving linear programming problems.
6. Simplex method. Optimality condition. Derivativation and the implementation of the simplex method. The use of linear programming for solving problems in the field of operations research.

LEARNING OUTCOMES

No.	LEARNING OUTCOMES
1.	Define the terms local and global minimum of functions in one and more variables.
2.	Apply methods to solve the problem of one-dimensional and multidimensional minimization with or without constraints.
3.	Explain the concepts related to multi-dimensional minimization with constraints.
4.	Identify optimization problems in different areas and daily life.
5.	Apply methods for one-dimensional and multi-dimensional minimization on examples from everyday life.
6.	Create function with simple linear programming problems and apply the simplex method for solving linear programming problems with interpretation of the results.
7.	Describe the range of applications, but also the limitations of linear programming methods.
8.	Apply at least one programming tool to implement the method and processed illustrative method for example.

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	1-8	Attending classes, discussions, teamwork, independent work on	Participant lists, monitoring activities to continue, tasks closed	0	4

			tasks and short Examination			
Homework	1	1-8	Solving programming tasks	Checking accurate solutions (evaluation)	0	4
Written exam (Mid-terms)	2	1-8	Preparing for written exams	Verification of correct answers (evaluation)	25	46
Final exam	2	1-8	Revising	Oral exam	25	46
TOTAL	6				50	100

Teaching methods and knowledge assessment. Lectures and exercises are compulsory. The exam consists of written and oral part, which can be taken after the lectures. Upon completion of the course, students can take the exam. Successful midterm exam scores replace the written exam. Exercises are partially auditory and partially laboratory with the use of computers. During the semester students can write homework or making seminar paper, which can contribute to the final grade.

Can a subject taught in English: Yes

Basic literature:

1. R. Scitovski, N. Truhar, Z. Tomljanović, Metode optimizacije, Sveučilište Josipa Jurja Strossmayera u Osijeku, Odjel za matematiku, Osijek, 2014.
2. Kuzmanović, K. Sabo, Linearno programiranje, Sveučilište Josipa Jurja Strossmayera u Osijeku, Odjel za matematiku, Osijek, 2016.

Recommended literature:

1. R. Scitovski, K. Sabo, D. Grahovac, Globalna optimizacija, Sveučilište u Osijeku, Odjel za matematiku, 2017.
2. R. Scitovski, Numerička matematika, Sveučilište u Osijeku, Odjel za matematiku, 2015.
3. C. T. Kelley, Iterative methods for optimization, SIAM, Philadelphia, 1999.
4. R.Plato, Concise Numerical Mathematics American Mathematical Society, Providence, 2003.
5. J. E. Dennis, Jr, R. B. Schnabel, Numerical Methods for Unconstrained Optimization and Nonlinear Equations, SIAM, Philadelphia, 1996.
6. D. Bertsimas, J. N. Tsitsiklis, Introduction to Linear Optimization, Athena Scientific, 1997.