M037	FIN, MR – Elective – Year 2	**Operational Research**	L+P+S 1+0+1	ECTS 3

Course objectives. The objective of this course is to make students familiar with fundamental operational research methods and their applications with stress on transportation problems, network flow problems and their applications. Special stress will be placed on problem observation, modelling and interpretation of results.

Course prerequisites. Linear Optimization.

Syllabus.

1. Introduction. Short revising of basic terms in linear optimization and linear programming.
2. The Network Flow Problem. Definition and formulation of the Network Flow Problem, The Flow Conservation Law, Equivalent Problems: The Transportation Problem, The Assignment Problem, Variants of the Network Flow Problem.
3. The Network Simplex Algorithm: Trees and Basic Feasible Solutions, Change of basis, The Simplex Method for Capacitated Problems.
4. The Maximum Flow Problem: Definition, Formulation of the Maximum Flow Problem, Ford-Fulkerson Algorithm, Searching for an augmenting path, Cuts in Graphs, Max-flow min-cut theorem.
5. Integer Programming Problems (The Knapsack Problem, Packing, Partitioning, Covering, The Traveling Salesman Problem, Scheduling Problems, etc.) Modelling techniques. Strong formulation of the problem. Modelling with exponentially many constraints.

Expected learning outcomes.

After completion of the course, students are expected to:

- demonstrate the knowledge and intelligence as the basis for the original work and development of ideas;
- apply their knowledge, understanding and ability to problem solving in a wider context in the area of operational research;
- be capable of integrating new knowledge in the area of operational research;
- be able to communicate their conclusions and supporting arguments to both experts and non-experts;
- possess the learning ability for continuing education and lifelong learning in this area.

Teaching methods and student assessment. Classes are organized through theoretical lectures and solving of real-life problems in seminars. Lectures and seminars are obligatory. The final examination consists of a written and an oral part and it is taken upon the completion of lectures. Acceptable results achieved in mid-term exams taken during the semester replace the written part of the exam. Students may influence their grade by doing extra-credit assignments or writing a seminar paper.

Can the course be taught in English: Yes.

Basic literature:

1. D. Bertsimas, J.N. Tsitsiklis, Introduction to Linear Optimization, Athena Scientific, Belmont, Massachusetts, 1997.

Recommended literature:

1. L. Neralić, Uvod u matematičko programiranje 1, Element, Zagreb, 2003.
2. G. Sierksma, Linear and Integer Programming, Marcel Dekker, Inc., 1999.
3. A. Schrijver, Theory of Linear and Integer Programming, John Wiley & Sons, Inc., NY, SAD, 1999.
4. R. Bronson, G. Naadimuth, Operation Research, Schaum's, McGraw Hill, New York, 1997.
5. C. H. Papadimitriou, H. Christos, Combinatorial Optimization, Prentice-Hall, N. J., 1982.
6. G. L. Nemhauser, A. L. Wolsey, Integer and Combinatorial Optimization, John Wiley & Sons, Inc.,1999.