Study Programme: Applied Mathematics – Data Science

Course Unit Title: Theory of algorithms

Course Unit Code: MDS21

Name of Lecturer(s): Boris B. Šobot

Type and Level of Studies: master

Course Status (compulsory/elective): elective

Semester (winter/summer): winter

Language of instruction: English/Serbian

Mode of course unit delivery (face-to-face/distance learning):

Number of ECTS Allocated: 6

Prerequisites: none

Course Aims: Handling basic notions of the theory of recursive functions and Turing machines, as two equivalent formalizations of the notion of algorithm; introduction to some important algorithms and the analysis of their complexity.

Learning Outcomes: Understanding recursiveness and connected notions with the capability of proving it; understanding the principles of Turing machines and ability to construct machines solving some simple problems; knowledge of some important algorithms and estimating their complexity.

Syllabus:

Theory The notions of primitive recursive and recursive functions. Methods for proving recursiveness. The Ackermann function. Recursive and recursively enumerable sets. Turing machines and some modifications. RAM machines. Calculating time and space complexity of an algorithm. Nondeterministic Turing machines. NP-completeness. Some important algorithms: Euclid's algorithm, algorithms on graphs, SAT problem and its restrictions.
Practice Checking primitive recursiveness of functions and sets. Applications to some important arithmetic functions. Some other connections between recursive and recursively enumerable sets. Constructing Turing machines in one element alphabet. Simulating composition, primitive recursion, sums and products and the search operator.

Required Reading:

1. Dolinka, Kratak uvod u analizu algoritama (Serbian), Faculty of Sciences, Novi Sad, 2008.
2. R. Tošić, S. Crvenković, Zbirka zadataka iz teorije algoritama (Serbian), Department of mathematics, Novi Sad, 1980.
3. C. H. Papadimitriou, Computational Complexity, Addison Wesley Longman, 1994.

Weekly Contact Hours: 4	**Lectures:** 2	**Practical work:** 2

Teaching Methods: Lectures are presented using classical teaching methods. Exercises are used to practice and analyze typical problems and their solutions. The ability of application of theoretical knowledge is checked through independent solving of exercises on two colloquia. The final exam is oral and a student is supposed to demonstrate general understanding of the presented theoretical material.

Knowledge Assessment (maximum of 100 points):

Pre-exam obligations	points	**Final exam**	points
Active class participation		written exam	
Practical work		oral exam	40
Preliminary exam(s)	60	…….	
Seminar(s)			

The methods of knowledge assessment may differ; the table presents only some of the options: written exam, oral exam, project presentation, seminars, etc.