

Study programme(s): Mathematics (MD)				
Level: doctoral studies				
Course title: Automata theory and formal languages (TI-02)				
Lecturer: Rozália S. Madarász-Szilagyí				
Status: elective				
ECTS: 10				
Requirements: none				
Learning objectives: Acquainting the students with concepts, results and techniques of automata theory and formal languages.				
Learning outcomes: Acquisition of concepts and methods which allow conducting research in automata theory and formal languages with a focus on algebraic methods.				
Syllabus: Algebras of languages. Regular expressions and regular languages. Foundations of the classical automata theory. Kleene's theorem. Syntax congruences and syntax semigroups. The Myhill-Nerode theorem and the minimal automaton. Kleene algebras. Identities of Kleene algebras. Matrix Kleene algebras. Semirings and their application in Theory of formal languages. Formal power series over semirings. Iterative theories, iterative semirings and elements of fixed point theory in computer science. Context-free languages and grammars: lambda elimination, parsing tree, reduced form, normal forms Chomsky and Greibach, pumping lemma. Pushdown automata and context-free languages. Parsing. Algorithmic problems for context free languages. Dyck languages. Parikh's Theorem. Varieties of regular languages. Pseudovarieties of finite semigroups. Eilenberg's correspondence theorem. Schutzenberger's theorem: aperiodic monoids and *-free languages, also other instances of Eilenberg's theorem. *-hierarchy of regular languages. Automata decomposition theory. Cascade product. Krohn-Rhodes cascade decomposition theorem for automata. Directable automata, Černý conjecture. Theory of languages over infinite words. ω -semigroups. Büchi automata. Basics of the tree automata theory. Tree automata. Weighted tree automata. Two-dimensional languages. Multidimensional automata, tiling systems. Languages on bipartially ordered sets. Bisemigroups. Parentheses automata.				
Literature 1. R. Madarasz, S. Crvenković, <i>Uvod u teoriju automata I formalnih jezika</i> , Univerzitet u Novom Sadu, Novi Sad, 1995. 2. R. Madarasz, S. Crvenković, N. Mudrinski, <i>Zbirka zadataka iz teorije automata</i> , Univerzitet u Novom Sadu, Novi Sad, 2006. 3. J.E.Hopcroft, J.D.Ullman, <i>Formal Languages and Their Relation to Automata</i> , Addison-Wesley, Reading, 1969. 4. J.E.Hopcroft, J.D.Ullman, <i>Introduction to Automata Theory, Languages and Computation</i> , Addison-Wesley, Reading, 1979. 5. G.E.Revesz, <i>Introduction to Formal Languages</i> , McGraw-Hill, New York, 1983.				
Weekly teaching load				Other: 0
Lectures: 2	Exercises 0	Other forms of teaching: 0	Student research: 6	
Teaching methodology Lecturing theory with constant student interaction.				
Grading method (maximal number of points 100)				
Pre-exam obligations		points	Final exam	
Colloquia		60	Oral exam	
			40	