DOCTORAL SCHOOL OF INFORMATICS
COMPLEX EXAM SUBJECT

Foundations of Computing (main subject)

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1. Alphabet, words, languages. Algorithmic problems. Kolmogorov complexity.
2. Finite automata and their variants. Deteministic and nondeterministic finite automata. Regular expressions, regular languages.
3. Generative grammars. Chomsky hierarchy. Context-free languages and pushdown automata.
4. Turing machines and their variants (multitape, multihead, nondeterministic). Turing machines as models for computing. Church thesis. Recurisve and recursively enumerable langauges.
5. Non-recursively enumerable languages. Non-decidable languages. Diagonal method. Universal Turing machine. Reduction Method. Post Correspondence Problem. Halting problem. Rice theorem.
6. Complexity of algorithms. Space- and time complexity of Turing machines. Complexity classes.
7. Complexity classes P and NP, P and NP completeness. Cook Theorem. Further NP-complete problems (SAT, TSP).
8. Complexity class PSPACE, PSPACE completeness. Complexity classes L and NL. Hard problems.
9. Recursive and partial recursive functions.

References:

1. J.E. Hopcroft, R. Motwani, J.D. Ullman: Introduction to Automata Theory, Languages, and Computation. Third Edition. Pearson, 2013
2. J. Hromkovic: Theoretical Computer Science. Introduction to Automata, Computability, Complexity, Algorithmics, Randomization, Communication, and Complexity. Springer, 1998.
3. M. Sipser: Introduction to the Theory of Computation. Third Edition, Cengage, 2012.