Program	Level	First cycle
	Name of the program	Theoretical Computer Science

COURSE

Course title	**Analysis and Synthesis of Algorithms**			
Course code	Semester	Course status	ECTS	Contact hours (L+AE+LE)
CS 310	V	Mandatory course	6	3+0+2
Lecturer				
Course Goals	This course investigates methods for designing efficient and reliable algorithms. It introduces several algorithm design strategies that build on data structures and programming techniques. These include induction, divide-and-conquer, dynamic programming, and greedy algorithms.			
Learning Outcomes	After completing this course the student must demonstrate the knowledge and ability to: - Use advanced mathematical methods to analyze and synthesize algorithms; - Understand standard advanced algorithmic techniques; - Understand classical algorithm design techniques; - Understand the randomization in solving hard computational problems;			

COURSE CONTENT

- Advanced algorithm analysis techniques;
- Analysis of iterative and recursive algorithms. O and Θ notations.
- Analysis of algorithms and recurrence relations. Master theorem.
- Proof of Algorithm Correctness by induction and loop invariant
- Some Techniques for Recursion Removal. Memoization
- Algorithm synthesis techniques
- Algorithmic Strategies: Brute-force algorithms, divide and conquer, greedy algorithms, dynamic programming, and transformations, recursive backtracking, branch and bound.
- Randomized algorithm. Monte Carlo and Las Vegas algorithms.
- Selection (deterministic &randomized): finding the median in linear time
- String Matching Algorithms (Knuth-Morris-Pratt, Rabin-Karp, Boyer-Moore).
- String Matching with Finite Automata
- Algebraic algorithms; integer and matrix multiplication.
- Fast-Fourier transform and applications;

LITERATURE

[1] Levitin, Anany. Introduction to the design and analysis of Algorithms, 3rd ed, Pearson, 2011
[2] Steven S. Skiena, The Algorithm Design Manual, Springer, 2008
[3] S. Dasgupta, C. H. Papadimitriou, and U. V. Vazirani, Algorithms, S. Dasgupta, 2006
[4] J. Kleinberg, E. Tardos, Algorithm Design, Pearson, 2006
[5] G. J. E. Rawlins: Compared to what? An introduction to the analysis of algorithms, Computer Science Press, 1992.
[6] T. H. Cormen, C. E. Leiseron, R. L. Rivest & C. Stein, Introduction to Algorithms, MIT Press, 2009.
[7] D. E. Knuth, The Art of Computer Programming, Volume 1-3: Fundamental Algorithms, Addison-Wesley, 1968.

STUDENT WORKLOAD (hours in a semester)

Lectures	45	Exercises	30	Individual work	75	T o t a l	150

GRADING			**REMARKS**
Criterion	Maximum points	Minimum points	
Midterm exams	45	22	
Projects	10		
Final exam	45	22	
T o t a l	100	55	