| 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:<br>- Use advanced mathematical methods to analyze and synthesize algorithms;<br>- Understand standard advanced algorithmic techniques;<br>- Understand classical algorithm design techniques;<br>- 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 | |