Program	Level	Second cycle
	Name of the program	Theoretical Computer Science

COURSE

Course title	**Metaheuristics**			
Course code	Semester	Course status	ECTS	Contact hours (L+AE+LE)
CS 533	III	Elective course	7	3+0+2
Lecturer				
Course Goals	The primary goal of this course is to introduce students to the basics of the theory of metaheuristic algorithms and apply them to solving challenging NP-complete problems.			
Learning Outcomes	At the end of this course, the students should acquire basic knowledge about metaheuristics and be able to apply them in solving complex combinatorial or continual problems.			

COURSE CONTENT

- Introduction. General about optimization problems.
- Stochastic optimization. Random and pseudo-random numbers.
- Random processes and random walks. Levy flights and a simplified version of Levy distribution.
- Marks chains. Metropolis-Hasting Algorithm (MHA). Ghate-Smith Markov optimization algorithm.
- Continuous and combinatorial optimization problems.
- Overview of heuristic algorithms. The division of heuristic algorithms. The determination of the best first (Best-first search).
- Hill Climbing algorithm. Iterated Greedy algorithm. The Greedy Randomized Adaptive Search Procedure (GRASP). Guided Local Search (GLS). Simulated Annealing (SA) algorithm. Quantum Annealing (QA) algorithm. Variable Depth Search (VDS). Extreme Optimization (EO).
- Nature-inspired algorithms. Genetic Algorithms (GA). Differential Evolution (DE). Bacteriological algorithms. Memetic Algorithm (MA). Scatter Search (SS) methods.
- An overview of metaheuristic algorithms that are not naturally inspired. Monte-Carlo method. Local search (LS). Multiple local searches. Variable Neighborhood Search (VNS) strategies.
- Swarm intelligence algorithms. Particle Swarm Optimization (PSO). Harmony Search (HS). Tabu Search (TS). Ant Colony Optimization (ACO). Bee Colony Optimization (BCO). Firefly Algorithm (FA). Cuckoo Search (CS) Algorithm. Bat Algorithm (BA)..

LITERATURE

[1] Osman I. H., Kelly J.P.: Metaheuristics: Theory and Applications, (1996), Kluwer Academic Publishers.
[2] Ribeirio C .C., Hansen P.: Essays and survays in Metaheuristics, (2002), Kluwer Academic Publishers Boston - Dordrecht - London.
[3] X.S Yang.: Nature-Inspired Metaheuristic Algorithms. 2nd edition, (2010), Luniver Press.
[4] Michalewicz, Z., Fogel, D.B.: How to Solve It: Modern Heuristics, (2004), Springer.
[5] Talbi, E.G: Metaheuristics-from design to implementation, (2009), Wiley & Sons Publications.

STUDENT WORKLOAD (hours in a semester)

Lectures	45	Exercises	30	Individual work	100	T o t a l	175

GRADING			**REMARKS**
Criterion	Maximum points	Minimum points	
Midterm exams	20	10	
Assignments	10	5	
Projects	30	15	
Seminar paper	10	5	
Final exam	30	20	
T o t a l	100	55	