Course code	
Type and description	Elective Course
ECTS credit	1
Course name	Modern numerical methods in optimization
Course name in Polish	Nowoczesne metody numeryczne w optymalizacji
Language of instruction	English
Course level	8 PRK
Course coordinator	prof. dr hab. inż. Paolo Di Barba
Course instructors	prof. dr hab. inż. Paolo Di Barba, dr hab. inż. Sławomir Hausman, prof. uczelni, dr inż. Łukasz Jopek
Delivery methods and course duration	(see table below)

	Lecture	Tutorials	Laboratory	Project	Seminar	Other	Total of teaching hours during semester
Contact hours	0	0	0	15	0	0	15
E-learning	No	No	No	No	No	No	
Assessment criteria (weightage)				1			

Course objective	The aim of the course is to ensure that the student has acquainted basic knowledge of modern optimization methods as a way to solve inverse problems arising in electromagnetics. Since the aim of engineering education is to solve problems in a numerical fashion, special effort will be devoted to strengthen the computational skills of the student.
Learning outcomes	After the completion of the course, the students should be able to: 1. formulate the given inverse problem as an optimization problem – W4, U4 2. select an appropriate optimization algorithm – W4, U4 3. code objective functions and constraints – U4 4. assess and discuss results – K1.
Assessment methods	Learning outcomes 1-4 –Oral presentation and discussion of the project work.
Prerequisites	Principles of electromagnetics (fields and circuits), basic knowledge of numerical methods, use of toolboxes like e.g. MatLab or SciLab.
Course content with delivery methods	Short theoretical introduction based on lecture notes: 1. Solving an inverse problem by minimizing an objective function 2. A challenge: minimizing without derivatives 3. Deterministic computing: Nelder-Mead simplex method 4. Powell's conjugate-direction method 5. Evolutionary computing: evolution strategy 6. Genetic algorithm 7. Nature-inspired computing: particle-swarm optimization 8. Wind-driven optimization 9. Handling constraints. No free-lunch theroem 10. Trading multiple objecitves: Pareto-like optimization 11. Benchmark: optimal shape design of a MEMS actuator (direct problem) 12. Benchmark: optimal shape design of a MEMS actuator (inverse problem) Problems to be solved by students: 1. Solution of a benchmark problem by means of deterministic computing 2. Solution of a benchmark problem by means of evolutionary computing

	3. Solution of a benchmark problem by means of nature-inspired computing
Basic reference materials	1. P. Di Barba, A. Savini, S. Wiak: "Field models in electricity and magnetism", Springer, 2008 2. P. Di Barba, S. Wiak: "MEMS: field models and optimal design", Springer, in press.
Other reference materials	1. Lecture notes by P. Di Barba
Average student workload outside classroom	10 h
Comments	
Last update	07.02.2022