Wrocław University of Science and Technology
Doctoral School

COURSE CARD

1. Basic information

Course name in English:	*Modern Evolutionary Computation*	
Course name in Polish:	*Nowoczesne Obliczenia Ewolucyjne*	
Number of hours:	30	
Type of course:	Elective course	
Form of course:	mixed forms (combination of lecture, seminar and laboratory)	
Code of course:	ITQ100343W/ W04ITT-SD0053W	
Course leader:	Michał Przewoźniczek	
Faculty of the course leader:	W4 Faculty of Information and Communication Technology	
Email address of the course leader:	michal.przewozniczek@pwr.edu.pl	
Scientific discipline(s) assigned to the course (doctoral students representing the marked disciplines can participate in the course):	Architecture and urban planning	☐
	Automation, electronic, and electrical engineering	☐
	Information and communication technology	☒
	Biomedical engineering	☐
	Chemical engineering	☐
	Civil engineering and transport	☐
	Mechanical engineering	☐
	Environmental engineering, mining, and energy	☐
	Mathematics	☐
	Chemical sciences	☐
	Physical sciences	☐
	Management and quality studies	☐

2. Objectives

C1 Getting the knowledge on the main state-of-the-art trends in the field of Evolutionary Computation

C2 Getting the ability to choose the appropriate optimizer for the optimization problem at hand

C3 Getting the ability to implement chosen metaheuristics efficiently

C4 Getting the ability of critical analysis of the obtained results

3. Content

Detailed information about the course content, including topics and form of classes.

No.	Topic	Number of hours	Form of classes
1	Organization classes. Basic optimization methods (lecture)	2	lecture

2	Continuous domains – problem features, optimizers features Continuous domains – how to be effective? Automated optimizer step choice	2	lecture
3	Continuous domains – problem features, optimizers features Continuous domains – how to be effective? Automated optimizer step choice	2	laboratory
4	Statistical analysis in continuous domains	2	lecture
5	Statistical analysis in continuous domains	2	laboratory
6	Genetic Algorithms – basics, parameter influence	2	lecture
7	Gray-box optimization, problem-dedicated techniques	2	lecture
8	Gray-box optimization, problem-dedicated techniques	2	laboratory
9	Population diversity – influence, classical and modern diversity preservation techniques	2	lecture
10	Population diversity – influence, classical and modern diversity preservation techniques	2	laboratory
11	Problem decomposition	2	lecture
12	Problem decomposition	4	laboratory
13	The basics of multi-objective optimization	2	lecture
14	The basics of multi-objective optimization	2	laboratory
15			Select form

4. Prerequisites

List of prerequisites relating to knowledge, skills and other competences for course participants.

1. Programming skill in C++, C#, or Java

2. The working knowledge and understanding of objective-oriented programming

5. Learning outcomes

List of learning outcomes at level 8 of the Polish Qualifications Framework assigned to the course (mark the learning outcomes in the last column).

Symbol	Learning outcome	
	KNOWLEDGE. Doctoral student knows and understands:	
SzD_W3	the main trends in the development of the scientific or artistic disciplines covered in the curricula;	☒
SzD_W4	research methodology;	☒
SzD_W5	the rules for the dissemination of scientific results, including in open access mode;	☐
SzD_W6	the fundamental dilemmas of modern civilization;	☐
SzD_W7	the legal and ethical conditions of scientific activity;	☐
SzD_W8	the economic and other relevant conditions of scientific activity;	☐

SzD_W9	basic principles of knowledge transfer to the economic and social spheres and commercialisation of results of scientific activity and know-how related to these results.	☐
	SKILLS. Doctoral student is able to:	
SzD_U2	use knowledge from different fields of science or art to creatively identify, formulate and innovatively solve complex problems or perform research tasks, in particular: - define the purpose and subject of scientific research, formulate a research hypothesis, - develop research methods, techniques and tools, and use them creatively, - draw conclusions on the basis of scientific research; critically analyse and evaluate the results of scientific research, expertise and other creative work and their contribution to knowledge development; transfer the results of scientific activities to the economic and social spheres;	☒
SzD_U3	communicate on specialised topics to the extent that they enable an active participation in the international scientific community;	☐
SzD_U4	disseminate research results, including in popular forms;	☐
SzD_U5	initiate debates and participate in a scientific discourse;	☒
SzD_U6	be able to speak a foreign language at B2 level of the Common European Framework of Reference for Languages to a level that enables them to participate in the international scientific and professional environment;	☐
SzD_U7	plan and implement an individual or collective research or creative activity, including in an international environment;	☐
SzD_U8	independently plan and act for one's own development and inspire and organize the development of others;	☐
SzD_U9	plan classes or groups of classes and implement them using modern methods and tools.	☐
	SOCIAL COMPETENCES. Doctoral student is ready to:	
SzD_K3	fulfilling the social obligations of researchers and creators, initiate public interest activities, thinking and acting in an entrepreneurial way;	☐
SzD_K4	maintaining and developing the ethos of research and creative environments, including: - carrying out scientific activities in an independent manner, - respecting the principle of public ownership of research results, taking into account the principles of intellectual property protection.	☐

6. Evaluation

Short description of the method(s) used to evaluate the learning outcomes assigned to the course, e.g., exam, test, report, presentation, etc.

During the course students will create their own optimizers. During the laboratory classes their propositions will be rated according to the knowledge presented on the lectures. The mark will be also dependent on the way students will present the reasoning and intuitions behind their propositions.

7. Teaching methods

Short description of the teaching methods used during the course, e.g., multimedia presentation, discussion, literature studies, developing written documents, own work, etc.

N1. Multimedia presentations (for the lecture part of classes)

N2. Documentation for the programming tasks (the laboratory part of classes)

N3. The e-learning system for publishing the educational materials

8. Literature

List of primary and secondary literature used to prepare the course and including additional knowledge for participants, e.g., books, textbooks, research papers, standards, web pages, etc.

[1] *Classes notes*
[2] Arabas J. *Wykłady z algorytmów ewolucyjnych*
[3] Michalewicz Z. *Genetic Algorithms + Data Structures = Evolution Programs*
[4] Michalewicz Z., Fogel D.B. *How to Solve It: Modern Heuristics*, WNT 2006
[5] Goldberg D. Genetic algorithms in search, optimization, and machine learning

9. Other remarks

Additional remarks, comments, (e.g., language of the course)

English