

**DOCTORAL SCHOOL OF WROCLAW UNIVERSITY OF SCIENCE AND
TECHNOLOGY**

SUPERVISOR/TEAM/ DECLARING/CONDUCTING COURSE: Prof. of WUST, Maciej Kruszyna, PhD, Eng.
DEPARTMENT: Civil Engineering Department
SCIENTIFIC DISCIPLINE: Civil Engineering and Transport

COURSE CARD

Course name in Polish: Metody heurystyczne w naukach inżynieryjno- technicznych

Course name in English: Heuristic methods in engineering and technical sciences

Course language: Polish

University-wide general course type*:

The course is intended for all PhD students: YES / NO

~~1) BASIC COURSE~~

2) SPECIALIST COURSE

~~3) SEMINAR~~

~~4) HUMANISTIC COURSE~~

5) LANGUAGE

Subject code: ILQ10025W

* delete as applicable

	Lecture	Foreign language course	Seminar	Mixed forms
Number of hours of organized classes in university (ZZU)	30			
Grading	Exam	Exam	Oral presentation	Exam, inspection, evaluation classes
Number of ECTS points	0			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. All qualifications at level 7 PRK (including obtaining engineering competences)
2. No additional requirements.

COURSE OBJECTIVES

- C1. Getting to know modern methods of optimization, searching for dependencies, solving patterns, modeling, data analysis, classification, approximation, review of possible applications
- C2. Evaluation of the applicability of a specific heuristic method to the issues studied by a PhD student
- C3. Increasing the efficiency of the review of current literature, indication of the potential topic (and periodical) for publication

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PROGRAM CONTENTS

Form of classes – lecture (Lec)		Number of hours
Lec1	The genesis of the heuristic approach, basic definitions	2
Lec2	Classification of heuristic methods, three classical methods, hybrid methods and "metaheuristics"	2
Lec3	Heuristic methods against the background of older methods of analysis	2
Lec4	Differences in the methods of analysis - discussion on the usefulness of the heuristic approach	2
Lec5	Basic procedures and elements of a detailed approach in genetic algorithms	2
Lec6	Basic procedures and elements of the detailed approach in fuzzy systems	2
Lec7	Basic procedures and elements of a detailed approach in neural networks	2
Lec8	Examples of analysis of issues in the field of engineering and technical sciences with the use of genetic algorithms	2
Lec9	Examples of analysis of issues in the field of engineering and technical sciences with the use of fuzzy systems	2
Lec10	Examples of analysis of issues in the field of engineering and technical sciences with the use of neural networks	2
Lec11	Selected procedures and elements of other methods (ant colonies, simulated annealing, swarm, cellular automata, etc.)	2
Lec12	Examples of analysis of issues in the field of engineering and technical sciences using other methods	2
Lec13	An attempt to assess the legitimacy of using a heuristic approach to selected current study issues (conducted by doctoral students) - discussion	2
Lec14	Examples of analyzes from literature similar to those discussed in lecture 13 (in the sense of the issues and methods used)	2
Lec15	Summary and formulation of topics for the exam	2
Total hours:		30

TEACHING TOOLS USED

- N1. multimedia presentation
 N2. personal computer, interactive whiteboard (calculations, drawings, descriptions)
 N3. discussion

ACHIEVED SUBJECT LEARNING OUTCOMES

Type of learning outcome	Code of learning outcome	Assessment of learning outcome
Knowledge	P8U_W	student competently quotes other authors in articles published and prepared for publication in peer-reviewed scientific journals, peer-reviewed materials from international scientific conferences, and in book editions preceding the preparation of a doctoral dissertation
Knowledge	P8S_WG	has knowledge at an advanced level of discipline and subject matter relevant to the field of research carried out, including the most recent research findings and scientific achievements

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Skills	P8S_UO	student is able to establish and undertake scientific cooperation in research teams, including international research teams is able to initiate and conduct discussions on research topics, results obtained and their interpretation
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PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Rutkowska D., Piliński M., Rutkowski L. „Sieci neuronowe, algorytmy genetyczne i systemy rozmyte”, Wydawnictwo Naukowe PWN, Warszawa 1999.
- [2] Rutkowski L. „Metody i techniki sztucznej inteligencji, Wydawnictwo Naukowe PWN, Warszawa 2009.
- [3] Białynicki – Birula I., Białynicka – Birula I. „Modelowanie rzeczywistości, WNT, Warszawa 2014.

SECONDARY LITERATURE:

- [1] Rosenberg G. (main editor) “Handbook of Natural Computing”, Springer-Verlag Berlin Heidelberg 2012
- [2] Current articles from: Transportation Research Part C, Engineering Applications of Artificial Intelligence, Journal of Heuristics, Fuzzy Sets and Systems, Neural Networks, European Journal of Operational Research

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

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