WROCŁAW UNIVERSITY OF TECHNOLOGY – PHD STUDIES

FACULTY OF …….

SUBJECT CARD

Course name in Polish	Modelowanie Agentowe Układów Złożonych
Course name in English	Agent based modeling of Complex Systems
Course language	**polish**
University-wide general course type: 1)basic course (mathematics, physics, chemistry, other) Departmental course developing professional skills: 1) specialized course 2) interdisciplinary course	
Type of course (obligatory, optional): optional	
Educational effects according to ZW 26/2017: P8U_W, P8S_WG, P8U_U, P8S_UW, P8S_UK, P8U_U	
Subject code**:** FZP9206W	

*delete as applicable

	Lecture	Laboratory	Seminar
Number of hours of organized classes in University (ZZU)	30		
Number of hours of total student workload (CNPS)	90		
Form of crediting	crediting with grade	Exam / crediting with grade*	Oral presentation
Number of ECTS points	3		
including number of ECTS points for practical (P) classes			
including number of ECTS points for direct teacher-student contact (BK) classes	2		

*delete as applicable **In case of didactic courses also inspections and evaluation classes

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical analysis and algebra - first degree level.
2. Basic skills in programming

SUBJECT OBJECTIVES	
C1	Students will learn about new methods in modeling complex systems and critical phenomena and interdisciplinary applications of these methods (in physics, geology, biology, sociology, economics, ergonomics, etc.)
C2	Students should acquire the ability to critical analysis of a given phenomenon that allows for the creation of a theoretical model
C3	Student should acquire the skills of oral and written presentation of results of scientific work in a form accessible for non-specialists in the field related to the present issue

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SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge:

PEK_W01 complex systems and interdisciplinary application of agent-based modeling
PEK_W02 analysis and modeling complex systems

Relating to skills:

PEK_U01 critical analysis of natural and social phenomena
PEK_U02 discussion and presenting knowledge in writing and oral form for non-specialists

Relating to social competences:

PEK_K01 awareness of the role of interdisciplinary collaboration
PEK_K02 awareness of the role of popularization of science

PROGRAMME CONTENTS		
Form of classes - lecture		Number of hours
Lec1	Introduction to complex systems and critical phenomena	2
Lec2,3	Limitations and advantages of analytical modeling - from population dynamics to the diffusion of innovation. Nonlinear dynamics.	4
Lec4	Random numbers and Monte Carlo simulations	2
Lec5,6	How to understand criticality? The power of simple microscopic models (percolation, Potts, clock, etc.)	4
Lec7	Self-organized criticality	2
Lec8	Blind and myopic ants – diffusion on networks. Models of epidemic spreading.	2
Lec9	Complex networks in reality	2
Lec10,11	Cellular automata – from a toy to a tool? (Wolfram CA, game of life, traffic and epidemic)	4
Lec12,13,14	Agent-based modeling in biology and social sciences: population dynamics, opinion dynamics and diffusion of innovation (Penna, voter, threshold, majority etc.)	6
Lec15	From agent-based to analytical model. Complete graphs.	2
	Total hours	**30**

Form of classes – laboratory		Number of hours
Lab 1		
Lab 2		
Lab 3		
Lab 4		
…		
	Total hours	

Form of classes – seminar	Number of hours

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Sem 1		
Sem 2		
Sem 3		
Sem 4		
…		
	Total hours	

TEACHING TOOLS USED	
N1	lecture, multimedia presentation
N2	homework, consultation
N3	discussions

EVALUATION OF ACHIEVED SUBJECT EDUCATIONAL EFFECTS		
Evaluation: F – forming (partial) C – concluding	Educational effect number	Way of evaluating achievement of educational effects
F1	P8U_W, P8S_WG, P8U_U, P8S_UW, P8S_UK, P8U_U	Presentation
F2		
…		
C=F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] I. Białynicki-Birula i I. Białynicka-Birula "Modelowanie Rzeczywistości. Jak w komputerze przeglada sie swiat.", WNT (2006)
[2] A. Fronczak, P. Fronczak "Świat sieci złożonych", PWN (2009)
[3] Original articles

SECONDARY LITERATURE:

[1] D. P. Landau, K. Binder, A Guide to Monte Carlo simulations in Statistical Physics, 2nd Edition, Cambridge University Press 2005.
[2] K. Christensen, N. R. Moloney, Complexity and Criticality, Imperial College Press 2005.
[3] M. Henkel, H. Hinrichsen, S. Lubeck, Non-Equilibrium Phase Transitions, Springer 2008.
[4] A. L. Barabási, "Network Science", Cambridge University Press (2016); online http://barabasi.com/networksciencebook/

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

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