Faculty of Fundamental Problems of Technology

COURSE CARD

Name in polish	:	**Algorytmy aproksymacyjne**
Name in english	:	**Approximation algorithms**
Field of study	:	Computer Science
Specialty (if applicable)	:	
Undergraduate degree and form of	:	masters, stationary
Type of course	:	optional
Course code	:	E2_W02
Group rate	:	Yes

	Lectures	Exercides	Laboratory	Project	Seminar
Number of classes held in schools (ZZU)	30	15	15		
The total number of hours of student workload (CNPS)	90	45	45		
Assesment	pass				
For a group of courses final course mark	X				
Number of ECTS credits	2	2	2		
including the number of points corresponding to the classes of practical (P)		2	2		
including the number of points corresponding occupations requiring direct contact (BK)	2	2	2		

PREREQUISITES FOR KNOWLEDGE, SKILLS AND OTHER POWERS

Algorithms and Data Structures or passing modules Discrete Optimization or Optimization Methods is recommended

COURSE OBJECTIVES

C1 Presenting techniques of constructing approximation algorithms for difficult optimization problems

C2 Mastering and theoretical analysis of the problems, algorithms and techniques discussed in the lecture

C3 Mastering techniques of constructing approximation algorithms

COURSE LEARNING OUTCOMES

The scope of the student's knowledge:

W1 Student knows what analysis of optimization problems and approximation algorithms is

W2 Student knows greedy techniques for designing approximation algorithms

W3 Student knows deterministic techniques for designing approximation algorithms (linear programming and deterministic rounding, primal-dual approach, iterative rounding)

W4 Student knows randomized techniques for designing approximation algorithms (linear programming and randomized rounding, derandomization techniques)

The student skills:

U1 Student is able to analyze approximation algorithms and their modifications presented during lectures

U2 Student can apply presented techniques for constructing approximation algorithms in practice

U3 Student can implement and experimentally analyze approximation algorithms for a selected optimization problem

The student's social competence:

K1 Student understands the need for fast approximation algorithms for solving hard optimization problems

COURSE CONTENT

Type of classes - lectures		
Wy1	The complexity of optimization problems	2h
Wy2	Greedy algorithms	2h
Wy3	Sequential algorithms for partitioning problems	2h
Wy4	Linear programming based algorithms	2h
Wy5	Algorithms for scheduling on uniform parallel machines	2h
Wy6	Primal-dual algorithms	2h
Wy7	Primal-dual algorithms for minimum multicut problem and for the maximum integer multi-commodity flow	2h
Wy8	Linear programming based algorithms (randomized rounding)	2h
Wy9	Algorithms for the integer multicommodity flow and for congestion routing problem	2h
Wy10	Approximation algorithms for packing problems	2h
Wy11	Iterative rounding based algorithms	4h
Wy12	Approximation schemes (FPTAS, PTAS)	2h
Wy13	Polynomial time approximation scheme for the jobshop problem	2h
Wy14	Test	2h

Type of classes - exercises		
Ćw1	Optimization problems	2h
Ćw2	Greedy techniques	4h
Ćw3	Techniques based on linear programming and deterministic rounding, primal-dual approach	4h
Ćw4	Techniques based on linear programming and randomized rounding	4h
Ćw5	Summary	1h

Type of classes - laboratory		
Lab1	Reminding languages and libraries for modeling and solving optimization problems	3h
Lab2	Programming project	4h
Lab3	Programming project	4h
Lab4	Programming project	4h

Applied learning tools

1. Traditional lecture
2. Multimedia lecture
3. Solving tasks and problems
4. Solving programming tasks
5. Consultation
6. Self-study students

EVALUATION OF THE EFFECTS OF EDUCATION ACHIEVEMENTS

Value	Number of training effect	Way to evaluate the effect of education
F1	W1-W4, K1-K1	
F2	U1-U3, K1-K1	
F3	U1-U3, K1-K1	
P=%*F1+%*F2+%*F3		

BASIC AND ADDITIONAL READING

1. V. Vazirani, Approximation Algorithms, Springer-Verlag, Berlin, 2001.
2. G. Ausiello, P. Crescenzi, G. Gambosi, V. Kann, A. Marchetti-Spaccamela, M. Protasi, Complexity and Approximation: Combinatorial optimization problems and their approximability properties Springer Verlag, ISBN 3-540-65431-3, 1999
3. D. P. Williamson, D. B. Shmoys, The Design of Approximation Algorithms, Cambridge University Press, ISBN: 9780521195270, 2010
4. D. Hochbaum (redaktor) Approximation Algorithms for NP-Hard Problems PWS Publishing Company, ISBN 0534949681, 1995

SUPERVISOR OF COURSE

dr hab. Paweł Zieliński

RELATIONSHIP MATRIX EFFECTS OF EDUCATION FOR THE COURSE
Approximation algorithms
WITH EFFECTS OF EDUCATION ON THE DIRECTION OF COMPUTER SCIENCE

Course training effect	Reference to the effect of the learning outcomes defined for the field of study and specialization (if applicable)	Objectives of the course**	The contents of the course**	Number of teaching tools**
W1	K2_W02	C1	Wy1-Wy14	1 2 5 6
W2	K2_W02 K2_W03_A K2_W04_A K2_W05	C1	Wy1-Wy14	1 2 5 6
W3	K2_W02 K2_W03_A K2_W04_A K2_W05	C1	Wy1-Wy14	1 2 5 6
W4	K2_W02 K2_W03_A K2_W04_A K2_W05	C1	Wy1-Wy14	1 2 5 6
U1	K2_U15 K2_U19_A	C2 C3	Ćw1-Ćw5 Lab1-Lab4	3 4 5 6
U2	K2_U09_A K2_U12_A K2_U15	C2 C3	Ćw1-Ćw5 Lab1-Lab4	3 4 5 6
U3	K2_U01_A K2_U08_A K2_U10 K2_U11 K2_U15	C2 C3	Ćw1-Ćw5 Lab1-Lab4	3 4 5 6
K1	K2_K08 K2_K13 K2_K14_A	C1 C2 C3	Wy1-Wy14 Ćw1-Ćw5 Lab1-Lab4	1 2 3 4 5 6