(*faculty stamp*)

COURSE DESCRIPTION

1. Course title: OPTIMIZATION AND DECISION MAKING	**2. Course code**
3. Validity of course description: 2016/2017	
4. Level of studies: BSc programme	
5. Mode of studies: intramural studies	
6. Field of study: MACROCOURSE	(FACULTY SYMBOL)
7. Profile of studies: general	
8. Programme:	
9. Semester: 3	
10. Faculty teaching the course: Institute of Automatic Control, Rau1	
11. Course instructor: dr hab. inż. Jarosław Śmieja	
12. Course classification: programme courses	
13. Course status: compulsory	
14. Language of instruction: English	
15. Pre-requisite qualifications: Calculus and differentia equations, Algebra and analytic geometry, Fundamentals of computer programming. Prior to this course, students should learn how to calculate derivatives, solve linear differential equations, perform calculations using matrix notation and develop simple software given the algorithm.	
16. Course objectives: Introduction of various types of practical optimization problems and analytical methods for solving them. Development of skills necessary for understanding and application of basic numerical algorithms. Introduction of mathematically based decision making in multistage decision processes. Laboratory exercises aim at teaching how to formulate an optimization problem in mathematical terms, implement theoretical results and standard algorithms to find solutions of real life optimization problems.	
17. Description of learning outcomes:	

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
W1	Student knows basic concepts in the field of optimization, e.g. functionals, convex functionals, local and global extrema, static and dynamic optimization, sufficient and necessary conditions	SP	WT, WM	K_W01, K_W16
W2	Student knows the form of necessary conditions used in optimization problems	SP	WT, WM	K_W16
W3	Student knows basic algorithms used in numerical methods of solving optimization problems	CL, PS	WT, WM	K_W13, K_W16, K_W24
U1	Student is able to describe mathematically typical optimization problems, determine the family they belong to, provide necessary conditions to be satisfied by the solution and use them to find the solution, and indicate methods that can be used to solve them	CL, PS	L	K_U07, K_U20
U2	The student can evaluate usefulness of standard methods for solving a given example and implement the chosen algorithm.	CL, PS	L	K_U20
U3	The student is able to use game theory-based methods for decision making	SP, CL, PS	L	K_U20

K1	The student can interpret the results obtained while solving an optimization or decision making problem, present and justify methods used to find the solution.	PS	L	K_K02, K_K03, K_K04

18. Teaching modes and hours

Lecture / BA /MA Seminar / Class / Project / Laboratory

Lecture 30 h./ Lab: 30h

19. Syllabus description:

Lectures

- Examples of optimization problems; defining optimality criteria
- Modeling of decision processes
- Unconstrained extrema
- Examples of using necessary conditions
- Constrained optimization
- Necessary conditions for constrained minimum
- Inequality constraints
- Convex programming
- Linear programming and simplex algorithm
- Dynamic programming
- Zero- and nonzero sum games
- Decision trees

Laboratory

- Analytical methods of solving constrained and unconstrained static optimization problems
- Optimization of functions of one variable
- Multivariable optimization
- Linear programming, simplex method
- Quadratic programming
- Direct methods of dynamic optimization, gradient methods
- Dynamic programming
- Zero-sum and non-zero-sum games in decision making

20. Examination: No

21. Primary sources:

A. Świerniak, A. Gałuszka, *Optimization Methods and Decision Making. Lecture Notes*. Wyd. Pol. Śl., Gliwice 2003.

Z. Ogonowski, J. Smieja, *Optimization Methods and Decision Making*. (Handbook for students) Art&Kolor, Gliwice, 2001. (available for download at http://www.platforma.polsl.pl/rau1/)

J. Kacprzyk, S. Kozieł, X. Yang, Computational Optimization, Methods and Algorithms, Springer, 2011 (available in the pdf format)

S. Seniutycz, J. Jeżowski, Energy Optimization in Process Systems and Fuel Cells, Elsevier, 2013 (available in the pdf format)

22. Secondary sources:

D. Luenberger: Optimization by vector space methods, John Wiley, 1969 (Polish translation-Teoria optymalizacji, PWN, 1974)

D. Luenberger: Introduction to linear and nonlinear programming, Adison-Wesley, 1973

U. Helmke, J. Moore: Optimization and dynamical systems, Springer, 1994

A. Bryson, Y.C. Ho: Applied optimal control, Blaisdell, 1969

W. Findeisen, J. Szymanowski, A. Wierzbicki: Metody optymalizacji, PWN, 1977

M.M. Sysło, N. Deo, J.S. Kowalik, Algorytmy optymalizacji dyskretnej, PWN, Warszawa, 1995

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	30/15
2	Classes	0/0
3	Laboratory	30/40
4	Project	0/0
5	BA/ MA Seminar	0/0
6	Other	6/5
	Total number of hours	66/60

24. Total hours:126

25. Number of ECTS credits: 5

26. Number of ECTS credits allocated for contact hours: 2

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects):3

26. Comments:

Approved:

…….
(date, Instructor's signature)

……
(*date , the Director of the Faculty Unit signature)*