FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Matematyczne metody optymalizacji**
Name in English:	**Mathematical optimisation**
Main field of study (if applicable):	**Industrial Control Engineering**
Specialization (if applicable):	**Automation and Control in Electrical Power Systems**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**obligatory**
Subject code:	**APR011309**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	30		15		
Number of hours of total student workload (CNPS):	90		60		
Form of crediting:	examination		crediting with grade		
For group of courses mark (X) final course:					
Number of ECTS points:	3		2		
including number of ECTS points for practical (P) classes :			2		
including number of ECTS points for direct teacher-student contact (BK) classes:	2.10		1.40		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. A basic knowledge of the properties of functions, calculus of functions of several variables, linear algebra.

SUBJECT OBJECTIVES

C1. Transfer of the basic knowledge and skills necessary for the proper formulation of optimization problems.
C2. Introduction to the basic methods of solving optimization problems.
C3. Training the skills in practical use of common software for solving optimization problems.

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01	knows the rules of mathematical formulation of the optimization problems.
PEU_W02	knows basic mathematical theorems on extreme functions of several variables, including the presence of constraints.
PEU_W03	knows the basic methods and algorithms for solving linear and nonlinear optimization tasks.

relating to skills:

PEU_U01	able to formulate a mathematical model of the optimization problem.
PEU_U02	able to select and use available software to solve optimization problems and correctly interpret the results.

relating to social competences:

PEU_K01	able to think and act in a creative and enterprising way

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Introduction. Basic concepts. The objective function, constraints, parameters.	2
Lec 2	Optimisation problem formulation. Examples of problems.	2
Lec 3	Mathematical preliminaries. Vectors and Matrices. Elements of differential calculus. Convex sets and functions.	2
Lec 4	Unconstrained problems. Optimality conditions for unconstrained problems.	2
Lec 5	Unconstrained minimization techniques. The steepest descent method. The Newton methods.	2
Lec 6	Conjugate gradient. Levenberg-Marquardt method. Non-gradient methods.	2
Lec 7	One-dimensional search methods. Golden section search.	2
Lec 8	Nonlinear constrained optimisation. Equality and inequality constraints. Kuhn-Tucker conditions.	2
Lec 9	Lagrangian function. Lagrangian duality.	2
Lec 10	Penalty methods.	2
Lec 11	Linear programming.	2
Lec 12	The simplex method. SLP method.	2
Lec 13	Integer programming.	2
Lec 14	Genetic algorithms. Basic concepts.	2
Lec 15	Genetic algorithms. Example of use.	2
	Total hours:	**30**

Form of classes - laboratory		**Number of hours:**
Lab 1	H&S regulations. Laboratory working rules. Rules for working in a group. Rules for final crediting.	1
Lab 2	Constructing a mathematical model of an optimization problem. Analytical determination of the extremum of a function.	2
Lab 3	The study of numerical methods for unconstrained problems.	2
Lab 4	The study of numerical methods for unconstrained problems.	2
Lab 5	The study of numerical methods for unconstrained problems.	2
Lab 6	The study of numerical methods for unconstrained problems.	2
Lab 7	Applying the Optimization Toolbox of Matlab.	2
Lab 8	Applying the Optimization Toolbox of Matlab.	2
	Total hours:	**15**

TEACHING TOOLS USED
N1. Lecture with multimedia presentations.
N2. Computer laboratory suitable for group working.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation *F – forming (during semester)* *P – concluding (at semester end)*	**Educational effect number**	**Way of evaluating educational effect achievement**
F1(W)	PEU_W01 PEU_W02 PEU_W03	Written exam.
P(W)	P=F1	
F1(L)	PEU_U01 PEU_U02 PEU_K01	Grading the correctness of optimization problem solutions.
P(L)	P=F1	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Podstawy optymalizacji, A. Stachurski, A. P. Wierzbicki, WPW 1999
[2] Metody rozwiązywania zadań optymalizacji, J. Seidler, A. Badach, W. Molisz, WNT 1980

SECONDARY LITERATURE:

[1] Teoria i metody obliczeniowe optymalizacji, W. Findensein, J. Szymanowski, A. Wierzbicki, PWN 1977
[2] Podstawy optymalizacji, F. Milkiewicz, Politechnika Gdańska 1995
[3] Practical Optimization Methods, M. Asghar Bhatti, Springer-Verlag 2000

SUBJECT SUPERVISOR
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