FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Metody numeryczne i metody optymalizacji**
Name in English:	**Numerical and Optimization Methods**
Main field of study (if applicable):	**Electrical Engineering**
Specialization (if applicable):	**Renewable Energy Systems**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**obligatory**
Subject code:	**ELR041330**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	15		15		
Number of hours of total student workload (CNPS):	60		30		
Form of crediting:	crediting with grade		crediting with grade		
For group of courses mark (X) final course:					
Number of ECTS points:	2		1		
including number of ECTS points for practical (P) classes :			1		
including number of ECTS points for direct teacher-student contact (BK) classes:	1.40		0.70		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about the properties of multivariable functions
2. Basic knowledge in the field of calculus
3. Basic knowledge in the field of matrix algebra

SUBJECT OBJECTIVES

C1. Transfer of the basic knowledge and skills needed for correct formulation of optimization problems
C2. Ordered presentation of various optimization methods
C3. Training the skills in practical use of software packages for solving optimization problems

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01 knows the rules of mathematical formulation of optimization problems
PEK_W02 knows basic methods and algorithms used to solve an optimization problem relating to skills

relating to skills:

PEK_U01 is able to formulate an optimization problem in mathematical terms
PEK_U02 is able to solve an optimization problem correctly selecting the solving algorithm

relating to social competences:

PEK_K01 creativity in searching for the solution of a given problem

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Introduction. Basic terms. Goal function, constrains, problem parameters. Formulation and classification of optimization tasks. Examples of problems.	2
Lec 2	Elements of calculus and matrix algebra related to optimization problems. Convex sets and convex functions	2
Lec 3	Nonlinear optimization without constrains. Sufficient and necessary conditions for optimization of unconstrained problems	2
Lec 4	Algorithms for unconstrained problems used for minimum search. Steepest descent algorithm. Conjugate gradient algorithm. Newton algorithm and quasi Newton methods	2
Lec 5	Minimum search of a one variable function. Golden section search algorithm	2
Lec 6	Nonlinear optimization with constrains. Kuhn-Tucker conditions. Lagrange function. Duality formulation	2
Lec 7	Penalty function methods. Linear optimization. Integer numbers optimization	2
Lec 8	Final test	1
	Total hours:	**15**

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. Preliminary conditions. Presentation of subsequent labs contents	1
Lab 2	Constructing a mathematical model of an optimization problem. Analytical determination of the extremum of a function	4
Lab 3	Research on the effectiveness of numerical algorithms dedicated for problems without constrains	4
Lab 4	Solving problems with constrains	2
Lab 5	Applying the Optimization Toolbox of Matlab	4
	Total hours:	**15**

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT		
Evaluation *F – forming (during semester)* *P – concluding (at semester end)*	**Educational effect number**	**Way of evaluating educational effect achievement**
F1(W)	PEK_W01 PEK_W02	Written final test
P(W)	P=F1	
F1(L)	PEK_U01 PEK_U02 PEK_K01	Grading the correctness of optimization problem solutions
P(L)	P=F1	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] .K.P. Chong, S.H. Żak: An Introduction to Optimization, 2nd edition, New York, John Wiley, 2001
[2] J.F. Bonnans: Numerical optimization: theoretical and practical aspects, Springer-Verlag, 2003
[3] M. Asghar Bhatti: Practical Optimization Methods, Berlin, Springer-Verlag 2000

SECONDARY LITERATURE:

[1] J. Nocedal, S. J. Wright, Numerical Optimization, Springer-Verlag, 2000

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
ELR041330 - Numerical and Optimization Methods
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering**
AND SPECIALIZATION **Renewable Energy Systems**

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2ETK_W02	C.1	Lec1 Lec2 Lec3	N.1
PEK_W02	K2ETK_W02	C.2 C.3	Lec4 Lec5 Lec6 Lec7 Lec8	N.1
PEK_U01	K2ETK_U02	C.1	Lab1 Lab2	N.2
PEK_U02	K2ETK_U02	C.2 C.3	Lab3 Lab4 Lab5	N.2
PEK_K01	K2ETK_K06	C.1 C.2 C.3	Lab1 Lab2 Lab3 Lab4 Lab5	N.1 N.2