FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Metody numeryczne w technice**
Name in English:	**Numerical methods in engineering**
Main field of study (if applicable):	**Electrical Engineering**
Specialization (if applicable):	**Industrial Electrical Engineering**
Level and form of studies:	**2nd level, part-time**
Kind of subject:	**obligatory**
Subject code:	**ELR042572**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	11			11	
Number of hours of total student workload (CNPS):	54			54	
Form of crediting:	crediting with grade			crediting with grade	
For group of courses mark (X) final course:					
Number of ECTS points:	2			2	
including number of ECTS points for practical (P) classes :				2	
including number of ECTS points for direct teacher-student contact (BK) classes:	1.40			1.40	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge in the scope of mathematics enabling understanding of basics of optimization and formulating and solution of simple optimization problems.
2. Knowledge of basics of numerical methods.
3. Abilities of developing computer programs and performing calculation in the Matlab environment.
4. The student is able to think and act creatively.

SUBJECT OBJECTIVES

C1. Acquiring knowledge in the scope of optimization calculation.
C2. Acquiring competence in performing optimization.
C3. Acquiring knowledge in the scope of the method of finite elements.
C4. Acquiring competence in using the method of finite elements.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01 The student knows optimization without constraints.
PEK_W02 The student knows principles of optimization with constraints.
PEK_W03 The student knows principles of the method of finite elements.

relating to skills:

PEK_U01 The student is able to perform optimization without constraints in the Matlab environment.
PEK_U02 The student is able to perform optimization with constraints in the Matlab environment.
PEK_U03 The student is able to use the method of finite elements in the Matlab environment.

relating to social competences:

PEK_K01 The student is able to think and act creatively.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	An introduction. Non-linear programming: problem formulating; analytical solving of problem without constraints, with equality and inequality constraints.	2
Lec 2	Numerical methods of solving problems of non-linear programming without constraints - minimizing functions of one and many variables. Numerical methods of solving problems of non-linear programming with constraints: direct and indirect algorithms.	2
Lec 3	Dynamic programming: multi-stage problem of dynamic programming, Bellman's principle of optimality, continuous problem of dynamic programming. Multi-criteria programming: methods of multi-criteria programming.	2
Lec 4	Genetic algorithms: principles, classical genetic algorithm, properties.	2
Lec 5	The method of finite elements: modelling with use of finite elements, the method of finite elements as a method of approximation of partial differential equations, areas of utilization of the method of finite elements.	2
Lec 6	Final test.	1
	Total hours:	**11**

Form of classes - project		**Number of hours:**
Proj 1	An introduction. Optimization without constraints.	2
Proj 2	Optimization with constraints.	2
Proj 3	Dynamic programming.	2
Proj 4	Optimization with use of genetic algorithms.	2
Proj 5	The method of finite elements.	2
Proj 6	Optimization with use of different methods.	1
	Total hours:	**11**

TEACHING TOOLS USED
N1. Multimedia presentation.
N2. Information lecture.
N3. Preparation in the form of reports.
N4. The Matlab programs.

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 PEK_W03	activity at the classes
F2(W)	PEK_W01 PEK_W02 PEK_W03	grades from the test
P(W)	P=0.1F1+ 0.9F2	
F1(P)	PEK_U01 PEK_U02 PEK_U03	activity at the classes
F2(P)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	reports from the classes
P(P)	P=0.3F1+ 0.7F2	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Bela M., Programowanie nieliniowe, teoria i metody, PWN, Warszawa 1983.
[2] Stadnicki J., Teoria i praktyka rozwiązywania zadań optymalizacji z przykładami zastosowań technicznych, WNT, Warszawa 2006.
[3] Goldberg D. E., Algorytmy genetyczne i ich zastosowania, WNT, Warszawa 1998.
[4] Łodygowski T., Kąkol W., Metoda elementów skończonych w wybranych zagadnieniach mechaniki konstrukcji inżynierskich, Wyd. PP, Poznań 1994.

SECONDARY LITERATURE:

[1] Michalewicz Z., Algorytmy genetyczne + struktury danych = programy ewolucyjne, WNT, Warszawa 1996
[2] Arabas J., Wykłady z algorytmów ewolucyjnych, WNT, Warszawa 2001.
[3] Zienkiewicz O.C., Taylor R.L., The finite element method, Butterworth-Heinemann 2000.
[4] Chandrupatla T.R., Belegundu A.D., Introduction to finite element method in engineering, Prentice-Hall International Editions 1991

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
ELR042572 - Numerical methods in engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering**
AND SPECIALIZATION **Industrial Electrical Engineering**

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 Lec4	N.1 N.2
PEK_W02	K2ETK_W02	C.1	Lec1 Lec4	N.1 N.2
PEK_W03	K2ETK_W02	C.3	Lec5	N.1 N.2
PEK_U01	K2ETK_U02	C.2	Proj1 Proj3 Proj4 Proj6	N.3 N.4
PEK_U02	K2ETK_U02	C.2	Proj2 Proj3 Proj4 Proj6	N.3 N.4
PEK_U03	K2ETK_U02	C.4	Proj5	N.3 N.4
PEK_K01	K2ETK_K02	C.2 C.4	Proj1 Proj2 Proj3 Proj4 Proj5 Proj6	N.3 N.4