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:	**ELR052172**
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):	30			30	
Form of crediting:	crediting with grade			crediting with grade	
For group of courses mark (X) final course:					
Number of ECTS points:	1			1	
including number of ECTS points for practical (P) classes :				1	
including number of ECTS points for direct teacher-student contact (BK) classes:	0.70			0.70	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student possesses knowledge of basic mathematical analysis, computer science, linear programming.
2. Student has practical skills in using Matlab software, Matlab programming, testing, debugging and running programs, including practical ability to implementation of the complex algorithms to m-files.

SUBJECT OBJECTIVES

C1. Understanding and mastering the advanced algorithms of selected numerical methods.

C2. Practical skills in the use of certain algorithms of numerical methods in engineering practice.

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01 Possess knowledge related to the methods of determining the eigenvalues and eigenvectors of a matrix. Possess knowledge related to singular value decomposition (SVD) of the matrix.Has knowledge of basic algorithms related to nonlinear least squares method.

PEU_W02 Has knowledge related to the nonlinear optimization by Newton's method. Has knowledge related to the gradient optimization methods: the gradient descent method, quasi-Newton method, as well as optimization with using of genetic algorithm.

PEU_W03 Has knowledge related to the basics of stochastic optimization. Has knowledge related to the numerical integration using Monte Carlo method.

relating to skills:

PEU_U01 Is able to algorithmization and formalization of any engineering task.

PEU_U02 Is able to apply the algorithms of numerical methods in engineering practice.

relating to social competences:

PEU_K01 Is able to carry out a complex engineering project in a competent way, unaided, undertaking multi-criteria analysis.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Introduction. Setting rules of course crediting. Methods for determining the eigenvalues and eigenvectors of the matrix. Singular value decomposition (SVD) of a matrix.	2
Lec 2	Non-linear least squares method: Gauss-Newton algorithm, Levenberg-Marquardt algorithm.	2
Lec 3	Introduction to nonlinear optimization methods: multidimensional function, Newton's method.	2
Lec 4	Gradient optimization methods: the gradient descent method, quasi-Newton method.	2
Lec 5	Optimization by Genetic Algorithm. Introduction to stochastic optimization. Numerical integration using Monte Carlo method.	2
Lec 6	Final test.	1
	Total hours:	**11**

Form of classes - project		**Number of hours:**
Proj 1	Introduction. Setting rules of course crediting. Determination of the eigenvalues and eigenvectors of selected matrix.	2
Proj 2	The study of non-linear least squares method: Gauss-Newton algorithm, Levenberg-Marquardt algorithm.	2
Proj 3	Optimization of non-linear multidimensional functions by Newton’s method.	2
Proj 4	Study of gradient optimization methods: the gradient descent method, quasi-Newton method.	2
Proj 5	Optimization of selected technical issues using genetic algorithms.	2
Proj 6	Presentation of the projects. Final evaluation.	1
	Total hours:	**11**

TEACHING TOOLS USED
N1. Lecture.
N2. Matlab software.
N3. Project presentation.

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	participation in lectures
F2(W)	PEU_W01 PEU_W02 PEU_W03	final test
P(W)	P = 0,1*F1 + 0,9*F2	
F1(P)	PEU_U01 PEU_U02	activity in classes
F2(P)	PEU_U01 PEU_U02	presentation of the passing projects
P(P)	P = 0,2*F1 + 0,8*F2	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Guttenbaum J., Modelowanie matematyczne systemów, Akademicka Oficyna Wydawnicza EXIT, Warszawa 2003.
[2] Kaczorek T., Wektory i macierze w automatyce i elektrotechnice, WNT, Warszawa 1998.
[3] Fortuna Z., Macukow B., Wąsowski J., Metody numeryczne. WNT, Warszawa 2003
[4] Stachurski M., Metody numeryczne w programie Matlab. Wydawnictwo MIKOM, Warszawa, 2003.

SECONDARY LITERATURE:

[1] Michalewicz Z., Algorytmy genetyczne + struktury danych = programy ewolucyjne. WNT Warszawa 1996.
[2] Jankowscy J. I M., Przegląd metod i algorytmów numerycznych, cz.1, WNT, Warszawa 1981
[3] Dryja M., Jankowscy J. I M., Przegląd metod i algorytmów numerycznych, cz.2, WNT, Warszawa 1982
[4] Kiełbasiński A., Schwetlick H., Numeryczna algebra liniowa, WNT, Warszawa 1992
[5] Krupka J., Morawski R.Z., Opalski L.J., Metody numeryczne dla studentów elektroniki i technik informacyjnych, Oficyna Wydawnicza Politechniki Warszawskiej Warszawa 1999
[6] Moler C., Numerical Computing with MATLAB. Electronic edition. Dostępny w: http://www.mathworks.com/moler/index.html
[7] Rosołowski E., Cyfrowe przetwarzanie sygnałów w automatyce elektroenergetycznej. Akademicka Oficyna Wydawnicza EXIT, Warszawa 2004.
[8] Bjorck A., Dahlquist G., Metody numeryczne, PWN, Warszawa 1987
[9] Baron B., Piątek Ł., Metody numeryczne w C++ Builder. Wydawnictwo Helion 2004
[10] Mathews J.H., Fink K.D., Numerical methods using MATLAB. Prentice Hall, 2004

SUBJECT SUPERVISOR
Piotr Pierz, piotr.pierz@pwr.edu.pl