FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Metody numeryczne**
Name in English:	**Numerical methods**
Main field of study (if applicable):	**Control Engineering and Robotics**
Specialization (if applicable):	
Level and form of studies:	**1st level, full-time**
Kind of subject:	**obligatory**
Subject code:	**ARR042104**
Group of courses:	**NO**

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

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.
3. Student is able to work alone.

SUBJECT OBJECTIVES

C1. Understanding and mastering the basic algorithms of numerical methods
C2. Practical skills in the use of basic algorithms of numerical methods in engineering practice

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01	Possesses knowledge related to the representation of numbers in a computer, and types of numerical errors. Possesses knowledge related to the methods for solving systems of linear and non-linear equations.
PEK_W02	Has knowledge of interpolation and approximation of the function.
PEK_W03	Has knowledge related to the numerical algorithms to integration and differentiation of functions, as well as to numerical solution of the differential equations.

relating to skills:

PEK_U01	Is able to algorithmization and formalization of any engineering task
PEK_U02	Is able to apply the basic algorithms of numerical methods in engineering practice

relating to social competences:

PEK_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. Issues of representation of numbers in computers. IEEE754 Standard. Correctness of algorithms, computational complexity. Errors of numerical procedures. Gauss elimination method for solving linear equations.	2
Lec 2	Matrix transformations, calculations of determinant and inverse of matrices. Iterative ethods of solving linear systems.	2
Lec 3	Solution of nonlinear equations: iterative methods, Aitken's method, bisection method, Newton method and secant method.	2
Lec 4	Systems of nonlinear equations: Newton-Raphson method.	2
Lec 5	Function interpolation: polynomial method. Linear least-squares problems: approximation of functions and data smoothing.	2
Lec 6	Numerical integration methods. Solving of ordinary differential equations. Single and multi-step methods.	2
Lec 7	Stability properties of numerical methods for solving differential equations.	2
Lec 8	Final test.	1
	Total hours:	**15**

Form of classes - project		**Number of hours:**
Proj 1	Introduction. Setting rules of course crediting. Acquaintance with lab stands and available software. Gauss algorithm to solve systems of linear equations. Using it to the matrix inversion.	2
Proj 2	Gauss–Seidel method to solve a linear system of equations.	2
Proj 3	Solving of nonlinear equations by a simple iteration and Aitken's method.	2
Proj 4	Solving nonlinear equations by Newton's method.	2
Proj 5	Solving of nonlinear equations systems by Newton-Raphson method. Graphical interpretation of solution.	2
Proj 6	Evaluation of the function interpolation by polynomial interpolation method.	2
Proj 7	Evaluation of the function approximation algorithms by the method of least squares with different basis functions.	2
Proj 8	The least square method with singular value decomposition of the matrix.	2
Proj 9	The use of approximation by the least squares method for smoothing and estimation of input data parameters.	4
Proj 10	Algorithms for numerical integration.	2
Proj 11	Rectangles and trapezoids method to solve differential equations - computer simulation of selected dynamic phenomena.	4
Proj 12	Solving of differential equations using system by Runge-Kutta IV-order method on the example of the dynamic simulation of selected dynamical phenomena.	2
Proj 13	Reserve date	2
	Total hours:	**30**

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

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	participation in lectures
F2(W)	PEK_W01 PEK_W02 PEK_W03	final test
P(W)	P=0,1*F1 + 0,9*F2	
F1(P)	PEK_U01 PEK_U02	activity in classes
F2(P)	PEK_U01 PEK_U02	presentation of the passing projects
P(P)	P=0,2*F1 + 0,8*F2	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Fortuna Z., Macukow B., Wąsowski J., Metody numeryczne. WNT, Warszawa 2003
[2] Stachurski M., Metody numeryczne w programie Matlab. Wydawnictwo MIKOM Warszawa 2003.

SECONDARY LITERATURE:

[1] Jankowscy J. I M., Przegląd metod i algorytmów numerycznych, cz.1, WNT, Warszawa 1981
[2] Dryja M., Jankowscy J. I M., Przegląd metod i algorytmów numerycznych, cz.2, WNT, Warszaw, 1982
[3] Kiełbasiński A., Schwetlick H., Numeryczna algebra, WNT, Warszawa 1992
[4] Krupka J., Morawski R.Z., Opalski L.J., Metody numeryczne dla studentów elektroniki i technik informacyjnych, Oficyna Wydawnicza Politechniki Warszawskiej Warszawa 1999
[5] Bjorck A., Dahlquist G., Metody numeryczne, PWN, Warszawa 1987
[6] Baron B., Piątek Ł., Metody numeryczne w C++ Builder. Wydawnictwo Helion 2004
[7] Mathews J.H., Fink K.D., Numerical methods using MATLAB. Prentice Hall, 2004
[8] Yang W.Y., Cao W., Chung T.-S., Morris J., Applied Numerical Methods Using MATLAB. Wiley-Interscience, 2005

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
ARR042104 - Numerical methods
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Control Engineering and Robotics**

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	K1AiR_W35	C.1	Lec1 Lec2 Lec3 Lec4	N.1
PEK_W02	K1AiR_W35	C.1	Lec5	N.1
PEK_W03	K1AiR_W35	C.1	Lec6 Lec7	N.1
PEK_U01	K1AiR_U31	C.2	Proj1 Proj2 Proj3 Proj4 Proj5 Proj6 Proj7 Proj8 Proj9 Proj10 Proj11 Proj12 Proj13	N.2 N.3
PEK_U02	K1AiR_U31	C.2	Proj1 Proj2 Proj3 Proj4 Proj5 Proj6 Proj7 Proj8 Proj9 Proj10 Proj11 Proj12 Proj13	N.2 N.3
PEK_K01	K1AiR_K04 K1AiR_K05	C.2	Lec8 Proj1 Proj2 Proj3 Proj4 Proj5 Proj6 Proj7 Proj8 Proj9 Proj10 Proj11 Proj12 Proj13	N.3