WROCŁAW UNIVERSITY OF TECHNOLOGY – PHD STUDIES

FACULTY of Fundamental Problems of Technology

SUBJECT CARD

Course name in Polish Macierze w technice i informatyce
Course name in English Matrices in technique and computer science
Course language Polish
University-wide general course type: 1)basic course (mathematics, physics, chemistry, other) 2) ~~humanity course~~ 3) ~~managerial skills~~ 4) ~~English language~~ 5) ~~other modern language~~ Departmental course developing professional skills: 1) specialized course 2) interdisciplinary course 3) seminar (interdisciplinary, specialized, departmental)
Type of course (obligatory, optional)
Educational effects according to ZW 26/2017: P8S_WG, P8S_UW, P8S_KR
Subject code MAP 9900

*delete as applicable

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

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

WROCŁAW UNIVERSITY OF TECHNOLOGY – PHD STUDIES

1. Linear algebra

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SUBJECT OBJECTIVES

C1 Geting to know selected algorithms of numerical algebra and their applications in technique and computer science

C2 Acquirement of skill of choice of appropriate numerical methods of algebra for solving different problems in technique and computer science

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge:

PEK_W01 Students knows decompositions of matrices and their applications

PEK_W02 Students knows functions of matrices nad matrix equations

PEK_W03 Student knows numerical algorithms of algebra applied in technique and computer science

Relating to skills:

PEK_U01 Students is able to analyze properties of numerical algorithms

PEK_U02 Students manages to select appropriate algorithms of numerical algebra to solving some problems of technique and computer science

PEK_U03 Students is able to plan numerical experiments and generate test matrices

Relating to social competences:

PEK_K01 Student is aware of social role of researches

PROGRAMME CONTENT

Form of classes - lecture		**Number of hours**
Lec 1	Basic notions of linear algebra	2
Lec 2	Decompositions of matrices: LU, Cholesky, QR, SVD, Schur. Image compression, low rank approximation.	2
Lec 3	Elementary transfomations applied in numerical algebra. Random test matrices.	2
Lec 4	Conditioning of system of linear equations. Floating point arithmetic, standard IEEE 754.	2
Lec 5	Variants ijk of Gauss elimination. Basic iterative algorithm for system of linear equations.	2
Lec 6	Conditioning of eigenvalues. Bisection method for computing eigenvalues of symmetric tridiagonal matrices.	2
Lec 7	QR method for eigenvalues of matrices.	2
Lec 8	Perron-Frobenius theory. PageRank method. Power method for computing eigenvalues.	2
Lec 9	Sylvester and Lyapunov matrix equation. Functions of matrices. Roots of matrices.	2
Lec 10	Algorithms for computing matrix sign function – applications to Riccati and Sylvester matrix equations.	2
Lec 11	Linear least squares problem – algorithms and conditioning.	2
Lec 12	Nonlinear least squares problem. Algorithm of Broyden, updating of QR decomposition.	2
Lec 13	Orthogonal Procrustes problem and its generalizations. Polar decomposition of matrix – algorithms.	2
Led 14	Tensor SVD. Face recognition and handwriting digits recognition by SVD and tensor SVD.	2

WROCŁAW UNIVERSITY OF TECHNOLOGY – PHD STUDIES

Lec 15	Open problems and new trends. Discussion.	2
	Total hours	30

TEACHING TOOLS USED
N1. Lectures N2. Discussion during lectures

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
P	PEK_W01, PEK_W02, PEK_W03, PEK_U01, PEK_U02, PEK_U03, PEK_K01	exam

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] L. Elden, *Matrix Methods in Data Mining and Patter Recognition*, SIAM, Philadelphia 2007.

[2] G.H. Golub, Ch.F. Van Loan, *Matrix Computation*, 4th Edition, Johns Hopkins Univ. Press, Baltimore 2013.

[3] N.J. Higham, *Functions of Matrices. Theory and Computation*, SIAM, Philadelphia 2008.

[4] A. Kiełbasiński, H. Schwetlick, *Numeryczna Algebra. Wprowadzenie do obliczeń zautomatyzowanych*, WNT, Warszawa 1992.

SECONDARY LITERATURE:

[1] A.J. Laub, *Matrix Analysis for Scientists and Engineers*, SIAM, Philadelphia 2005.

[2] C.D. Meyer, *Matrix Analysis and Applied Linear Algebra*, SIAM, Philadelphia 2000.

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

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