UCL Université catholique de Louvain

LINMA2380

2013-2014

Matrix theory

5.0 credits	30.0 h + 22.5 h	1q

Teacher(s) :	Van Dooren Paul ;
Language :	Français
Place of the course	Louvain-la-Neuve
Inline resources:	> http://icampus.uclouvain.be/claroline/course/index.php?cid=INMA2380
Prerequisites :	Basic knowledge (1st cycle) in linear algebra and numerical analysis.
Main themes :	-- Matrices defined over a field: equivalence classes, Gaussian elimination, determinants, generalized inverses and singular value decomposition with applications -- Canonical forms under general or orthogonal similarity transformations -- Localization and perturbations of eigenvalues, inertia of a matrix -- Matrices defined over a ring: Euclid's algorithm and applications in polynomial matrices, relation to the Smith canonical form -- Non-negative matrices and the theory of Perron-Frobenius -- Structured matrices: complexity of fast algorithms for Toeplitz and Hankel matrices
Aims :	After successful completion of this course, the student will : -- have acquired a solid basis of matrix theory and its applcations in several engineering disciplines -- understand the use of matrix properties in the solution of these problems -- have acquired a solid background in matrix problems involving eigenvalues, singular values, non-negative and polynomial matrices -- have shown how to apply his theoretical background in concrete matrix problems. *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".*
Evaluation methods :	The evaluation of the students is partly based on an exam organized according to the rules imposed by the EPL. The exam material corresponds to the contents of the course material, with the possible exception of certain parts specified in a document available on iCampus after the last session of the course. The other part of the evaluation is based on the homeworks made during the semester. More elaborate information on the on the evaluation procedure is given in the course plan, made available on iCampus at the beginning of the academic year.
Teaching methods :	-- Regular classes with a schedule fixed by the EPL. -- Exercises or homeworks made individually or in small groups, with the possibility to consult teaching assistants. Solutions to the problems are made available afterwards.
Content :	After an introduction recalling some basic notions, we discuss the following topics: -- Complements on determinants -- The singular value decomposition and its applications -- Angles between subspaces, generalized inverses, projectors, least-squares problems -- Eigenvalue decomposition: Schur and Jordan form -- Approximations and variational characterization of eigenvalues --

	Congruence and stability: inertia, Lyapunov equation, stability analysis of dynamical systems -- Polynomial matrices: Euclid algorithm and the Smith normal form -- Non-negative matrices: Perron-Frobenius theorem, stochastic matrices -- Structured matrices: fast algorithms for Toeplitz and Hankel matrices.
Bibliography :	The course material consists of reference books, course notes and complimentary material made available via iCampus. Reference books : -- G.H. Golub and C.F. Van Loan (1989). Matrix Computations, 2nd Ed, Johns Hopkins University Press, Baltimore. -- P. Lancaster and M. Tismenetsky (1985). The Theory of Matrices, 2nd Ed, Academic Press, New York
Cycle and year of study :	> Master [120] in Mathematics > Master [120] in Physics > Master [120] in Mathematical Engineering > Master [120] in Statistics: General > Master [120] in Electro-mechanical Engineering > Master [120] in Electrical Engineering
Faculty or entity in charge:	MAP