{ KARTA OPISU MODUŁU KSZTAŁCENIA } **Training module description form**

Name of the module/subject	Code
Selected Topics in Mathematics	**1010802111010342874**

Fidel of study	Education profile	Year / Semester
Electronics and Telecommunications	**general academic**	**1 / 1**

Specialization area	Lecturing language:	Type of the course:
Information and Communication	**English**	**obligatory**

Study llevel:	**Study form:**
II level	**stationary**

Hours	Scores:
Lectures: **3** Classes: **3** Laboratories **-** Projects/seminars: **-**	**6**

Status in the study programme:	(ogólnouczelniany, z innego kierunku)
basic	**general academic**

Fidel(s) of training, area(s) of scence and arts:	**ECTS (number and %)**
technical sciences	**6 100%**
technical sciences	**6 100%**

Lecturer:

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Prerequisities:

1	Knowledge:	Higher mathematics trained in the first course.
2	Skills:	An applying of theorems of mathematical analysis, linear algebra and the theory of differential equations to calculate limits, derivatives and integrals, to solve sales, to find solutions to LODE1 and LODE2 with constant coefficients
3	Social competence	Awareness in the need the knowledge and practical skills has to be deepened and expanded

Aim of the course:

Learning the mathematical methods (both theoretical and practical ones) which are used in telecommunications and signal theory.

Efects:

Knowledge:

Deepened and expanded knowledge in mathematics, up to be used in understanding and formulation of problems considered in electronics and telecommunications, in particular in the information theory and in the coding theory.

[[K2_W00]], [[K2_W03]], [[K2_W05]]

Skills:

Reading of mathematical formulae and texts, their adaptation to real-world problems, as well as the ability to model real-world problems (here: that treated in electronics and telecommunication) via mathematical structures - [[K2_U05]], [[K2_U09]]

Communication in written and spoken English on professional matters, in particular efficient reading of English texts (books, technical and scientific journals, application notes, catalogs, manuals) - [[K2_U01]]

Social competence:

1. The understanding of the role played by IT environment in the development of the country - [[K2_K02]]

2. An awareness that there are needed a reliable approach to problems treated in professional activity and an undertaking the responsibility for the proposed technical solutions. - [[K2_K05]]

Ways to check the effects of education

Classes. Activity in classes. At least two tests covering both concepts and properties, as well as solving problems presented in lectures and/or discussing analogous ones in classes.
Lectures. Final exam.

Contents of the course

1. General view on mathematics: maths as a separate, non-physical world, mathematical logics and the set theory, an equivalence relation and a function.
2. Complex functions.
3. Repetition and extension of knowledge in linear algebra: an inner product of vectors (and its realization via Pearson correlation coef.); a system of algebraic linear equations (sale) and its condition number, a polynomial collocation and a least-square fit; a vector product of vectors; additive and multiplicative decomposition of matrices (A=L+D+U, A=LU, A=QR); algebraic/matrix eigenproblem; singular values.
4. Matrix exponential, exp(A), and system w'=Aw+b
5. Elements of grach theory, incl. matrix representations of a graph.
6. Groupoid/magma, semigroup, monoid, group. Matrix representation of a group.
7. Linear space of a finite dimension (and its basis), that of infinite dimension. Metric space, norm space, unitary space, Hilbert space, Banach space.
8. Integral and discrete Fourier transformations. Fourier polynomials and series. Wavelets.
9. Ordinary differential equation (ODE); Sturm-Liouville ODE (and orthogonal polynomials related to them); power series and hypergeometric functions.
10. Linear partial differential equation (PDE): recognition of the type of PDE2; exact/analytic and approximate/numerical solutions to parabolic, hyperbolic and elliptic PDEs.
11. Nonlinear PDE, e.g., sine-Gordon, Korteweg de Vries, Euler-Poisson-Darboux.
12. Linear and nonlinear difference equation (incl. logistic difference eqn, Lotke-Volterra system).
13. Internet page ranking, its linear algebra and Markov process aspects.

There are signalized issues considered in the field of electromagnetic field theory, circuit theory, signal theory, information theory and coding, and in numerical methods and statistics (e.g., two-dimensional wave equation is derived on the base of random walk).

Basic literature:

1967 L. E. Franks – *Signal theory*, Prentice-Hall Inc.
1982 W.Kołodziej – *Wybrane rozdziały analizy matematycznej*, PWN (wyd.2).
1983 Garett Birkhoff, Thomas C. Bartee – *Współczesna algebra stosowana*, PWN;
oryg. *Modern applied algebra*, McGraw-Hill Book Company 1970 (3rd printing).
1991 A.Marlewski – *Algebra i teoria grafów dla studentów politechnik*, Wydawnictwo Politechniki Poznańskiej.
1997 Alexei I. Kostrikin, Yu.I. Manin – *Linear algebra and geometry*, Gordon and Breach Science Publishers.
1997 L.Trefethen, D.Bau – *Numerical linear algebra*, SIAM Publishing.
1999 Carmen Chicone – *Ordinary differential equations with applications*, Springer.
2002 P. Brémaud – *Mathematical principles of signal processing. Fourier and wavelet analysis*, Springer.
2002 A. D. Polyanin – *Handbook of linear partial differential equations for engineers and scientists*, Chapman & Hall/CRC.
2002 A.D. Polyanin, V.F. Zaitsev – *Handbook of exact solutions for ordinary differential equations*, Chapman & Hall/CRC.
2004 Lloyd Jaisingh, Frank Ayres – *Schaum's outline of theory and problems of abstract algebra*, McGraw-Hill.
2005 S. Elaydi – *An introduction to difference equations*, Springer.
2005 Paul Cull, Mary Flahive, Robby Robson – *Difference equations. From rabbits to chaos*, Sprinter.
2007 J.Szabatin – *Podstawy teorii sygnałów*, WKŁ.
2007 M..Soare, P. P.Teodorescu, I. Toma - *Ordinary differential equations with applications to mechanics*, Springer.
2009 Ravi P. Agarwal, Donal O'Regan - *Ordinary and partial differential equations with special functions, Fourier series and boundary value problems*, Springer.
2009 Dennis G. Zill, Michael R. Cullen – *Differential equations with boundary value problems*, Brooks/Cole.
2010 A.Marlewski – *Algebra macierzy liczbowych dla studentów politechnik*, NAKOM.
2015 Thomas Judson – *Abstract algebra. Theory and applications*, Orthogonal Publishing.

Additional sources, a.o.:

1992 L.Babai, P. Frankl - *Linear algebra methods in combinatorics with applications to geometry and computer science*, Dpt.Computer Science, Uni.Chicago.
1997 Charles Van Loan – *Computational Frameworks for the Fast Fourier Transform*, SIAM.
2000 Moon T.K. i Stirling W.C. – *Mathematical methods and algorithms for signal processing*, Prentice Hall.
2005 A.Tarantola - *Inverse problem theory and methods for model parameter estimation*, SIAM.
2005 A.N. Lagville, C.D.Meyer - *A survey of eigenvector methods for web information retrieval*, SIAM Review Vol.47,No.1,pp.135-161.
2006 A.N. Langville, C.D. Meyer – *Google's PageRank and Beyond: The Science of Search Engine Rankings*. Princeton.
2015 D.F. Gleich – *PageRank beyond the Web*, SIAM Review Vol.57,No.3,pp.321-363.
2014 H.Barboucha, M.Nasri - *The matrix method to calculate page rank*, Int.J.Engin. Research and Apps. 4, 6, pp.55-58

Balance of time a student should dedicate to dominate the course

Activity	Hours
1. Participation in lactures and classes	90
2. Student's individual work	90

Student workload

activity form	hours	ECTS
total	180	6
under lecturer's supervision	90	3
practical	90	3

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