Univerzita
Pardubice
Fakulta elektrotechniky
a informatiky

Doctoral Study Programme
Faculty of Electrical Engineering and Informatics

Study programme: P2612 Electrical Engineering and Informatics
Field of Study: 2612V070 Information, Communication and Control Technologies
Degree Acquired: Doctor of Philosophy, abbr. "Ph.D."
Length of Study: 4 academic years
Form of Study: full-time, part-time

Subjects:

A - Compulsory Subject
English for Scientists – PhDr. Jitka Hloušková, Ph.D.

B – Compulsory Optional Subjects
Selected Chapters from Applied Mathematics – doc. RNDr. Bohdan Linda, CSc.
Selected Chapters from Control Theory – doc. Ing. František Dušek, CSc.
Stochastic Processes – doc. RNDr. Bohdan Linda, CSc.

C – Optional Subjects
Advanced Signal Processing Methods –doc.Ing.Aleš Filip,CSc./prof.Ing.Pavel Bezoušek,CSc.
Continuous Systems Modelling and Simulation – doc. Ing. František Dušek, CSc.
Discrete Simulation of Technological Processes – prof. Ing. Antonín Kavička, Ph.D.
Electromagnetic and Optical Wave Propagation in Atmosphere and Near the Terrain – doc. Ing. Ondřej Fišer, CSc.
Method of Artificial Intelligence – prof. Ing. Ivan Taufer, DrSc.
Nonlinear Control Systems – doc. Ing. Jan Cvejn, Ph.D.
Optimalization and Optimal Control of Technological Processes – doc. Ing. Jan Cvejn, Ph.D.
Selected Chapters from Math Statistics – doc. Ing. Milan Javůrek, CSc.
Selected Chapters of Applied Physics – prof. Ing. Simeon Karamazov, Dr.
Selected Subjects from Algorithms and Data Structures – prof. Ing. Antonín Kavička, Ph.D.
Signal Propagation in Mobile Communication – prof. Ing. Vladimír Schejbal, CSc.
Theory of Digital Communication – prof. Ing. Pavel Bezoušek, CSc.
Theory of Microwave Antennas – prof. Ing. Vladimír Schejbal, CSc.
Theory of Modern Radar Systems – prof. Ing. Pavel Bezoušek, CSc.

Course description

Department/Unit /	JC / IDA0H			**Academic Year**	2012/2013
Title	English for Scientists - B2			**Type of completion**	Zkouška
Accredited/Credits	Yes, 0 Cred.			**Form of examination**	Combined
Number of hours					
Occ/max	Status A	Status B	Status C	**Course credit prior to**	NO
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	NO
Winter semester	0 / -	0 / -	0 / -		not determined
Language of instruction	Czech			**Repeated registration**	NO
Substituted course	JC/IDAH			**Semester taught**	Winter, Summer
Preclusive courses	N/A				
Prerequisite courses	N/A				
!Předměty informativně doporučené	N/A				

Course objectives:

The course enables the students to improve their communicative competence with a focus on reading comprehension in ESP and written as well oral text production. The target level is CEFR B2 in general English and corresponding linguistic competences and skills in ESP.

Requirements on student

The students will complete the course by presenting a paper on a specific topic related to their dissertation at a simulated scientific conference. The presentation will be followed by a discussion, in which members of the examination board as well as the audience can take part.

Content

The course content is designed to expand the communicative competence with an emphasis on specific language in information, communication and control technologies. It reflects selected topics related to the dissertation.

Prerequisites - other information about course preconditions

Communicative competence on the B1 level in general English a ESP.

Competences acquired

Upon a successful completion of the course, the student uses the language effectively and independently in complex, professionally oriented communicative situations and is able to work independently with specialized, field oriented literature. The target level is B2.

Guarantors and lecturers

- **Guarantors:** PhDr. Jitka Hloušková, Ph.D.

Literature

- **Recommended:** Redston, C., Cunningham, G. *Face2Face Intermediate*. CUP, 2006. ISBN 978-0-521-60336-2.
- **Recommended:** Redston, C., Cunningham, G. *Face2Face Upper Intermediate*. CUP, 2007. ISBN 978-0-521-60337-9.
- **Recommended:** Glendinning, E. H., Glendinning, N. *Oxford English for Electrical and Mechanical Engineering*. OUP, 2001. ISBN 0-19-457392-3.
- **Recommended:** Glendinning, E. H., McEwan, J. *Oxford English for Information Technology*. OUP, 2006. ISBN 0-19-457492-X.
- **Recommended:** Jones, L. *Working in English*. CUP, 2001. ISBN 0-521-77684-8.

Teaching methods

Work with text (with textbook, with book)
Skills training

Assessment methods

Oral examination

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2012	Povinné	A		
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2012	Povinné	A		
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2012	Povinné	A		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2012	Povinné	A		

Course description

Department/Unit /	UMKM / IDSAM			**Academic Year**	2013/2014
Title	Selected Chapters from Applied Mathemati			**Type of completion**	Zkouška
Long Title	Selected Chapters from Applied Mathematics				
Accredited/Credits	Yes, 0 Cred.			**Form of examination**	Combined
Number of hours					
Occ/max	Status A	Status B	Status C	**Course credit prior to**	NO
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	NO
Winter semester	0 / -	0 / -	0 / -		not determined
Language of instruction	Czech			**Repeated registration**	NO
Substituted course	!Žádný			**Semester taught**	Winter, Summer
Preclusive courses	N/A				
Prerequisite courses	N/A				
!Předměty informativně doporučené	N/A				

Course objectives:

The target of the subject is to deepen and extend the mathematical knowledge in the selected mathematical areas and to provide them the tools that are necessary for the solution of the problems

Requirements on student

Student must be able to make the prescribed subject matted up from the theoretical and practical view.

Content

Advanced matrix calculus.
Numerical mathematics.
Graphs and nets.
Tensor calculus.
Partial differential equation and their systems.
Extensive systems of linear differential equations.
Selected systems of the non-linear differential equations.
Integral equations.
Variation calculus with applications.
Stability of solution in mathematics.

Prerequisites - other information about course preconditions

Knowledge of mathematics and probability is assumed in the range that is usual at the technical universities

Competences acquired

Student will be able to use these methods independently at the solution of the concrete examples from the branch of student´s doctoral study

Guarantors and lecturers

Literature

- **Basic:** Leon, S.J. *Linear Algebra with Applications*. New Jersey, Prentice Hall, 1994.
- **Basic:** V. M.; FOMIN, S. V.; TICHOMIROV, V. M. *Matematická teorie optimálních procesů*. Academia, Praha, 1991.
- **Basic:** BARTÁK, L.; HERRMANN, L.; LOVICAR, V.; VEJVODA, O. *Parciální diferenciální rovnice*. SNTL, Praha, 1998.

- **Recommended:** BENSOUSSAN, A.; LIONS, J. L. *Impulsnoje upravlenje i kvazivariacionnyje neravenstva*. Nauka, Moskva, 1987.

Teaching methods

Monologic (reading, lecture, briefing)
Dialogic (discussion, interview, brainstorming)

Assessment methods

Oral examination

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Povinně volitelné	B		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Povinně volitelné	B		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Povinně volitelné	B		
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Povinně volitelné	B		

Course description

Department/Unit /	UMKM / IDSNP			**Academic Year**	2013/2014
Title	Stochastic Processes			**Type of completion**	Zkouška
Accredited/Credits	Yes, 0 Cred.			**Form of examination**	Combined
Number of hours					
Occ/max	Status A	Status B	Status C	**Course credit prior to**	NO
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	NO
Winter semester	0 / -	0 / -	0 / -		not determined
Language of instruction	Czech			**Repeated registration**	NO
Substituted course	!Žádný			**Semester taught**	Winter, Summer
Preclusive courses	N/A				
Prerequisite courses	N/A				
!Předměty informativně doporučené	N/A				

Course objectives:

The target of the subject is to make the students acquainted with the selected topics from the stochastics processes theory.

Requirements on student

Student must be able to make the prescribed subject matted up from the theoretical and practical view.

Content

Random process, basic types of random processes, point processes.
Poisson's process.
Spectral decomposition of the random processes.
Modeling of the stochastic processes.
Markov´s processes, Markov´s chains.
Queuing theory, basic terms, Kendall's classification, queues regimes. System M/M/n,
Non- Markov´s queuing systems - M/D/1, M/G/1, M/Ek/1.
Inventory theory - deterministic and stochastic models.
Renewal theory - models s punished and backfiring elements.

Prerequisites - other information about course preconditions

Knowledge of mathematics and probability is assumed in the range that is usual at the technical universities

Competences acquired

Student will be able to use these methods independently at the solution of the concrete examples from the branch of student´s doctoral study

Guarantors and lecturers

Literature

- **Basic:** Hillier,S.F.,Lieberman,G.J. *Introduction to Operations Research*. McGraw Hill, 2001. ISBN 0-07-121744-4.
- **Basic:** Linda, B. *Stochastické modely operačního výzkumu*. Statis, Bratislava 2004, 2004. ISBN 80-85659-33-6.
- **Recommended:** Ventcelová,E.S. *Teória prvděpodobnosti*. Alfa, Bratislava, 1973.

Teaching methods

Monologic (reading, lecture, briefing)
Dialogic (discussion, interview, brainstorming)

Assessment methods

Oral examination

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Povinně volitelné	B		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Povinně volitelné	B		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Povinně volitelné	B		
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Povinně volitelné	B		

Course description

Department/Unit /	KRP / IDSAR			**Academic Year**	2013/2014
Title	Selected Chapters from Control Theory			**Type of completion**	Zkouška
Accredited/Credits	Yes, 0 Cred.			**Form of examination**	Combined
Number of hours					
Occ/max	Status A	Status B	Status C	**Course credit prior to**	NO
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	NO
Winter semester	0 / -	0 / -	0 / -		not determined
Language of instruction	Czech			**Repeated registration**	NO
Substituted course	!Žádný			**Semester taught**	Winter, Summer
Preclusive courses	N/A				
Prerequisite courses	N/A				
!Předměty informativně doporučené	N/A				

Course objectives:

The aim is to inform students about advanced methods of control design of linear dynamic continuous systems in discrete-time area. Attention is paid to next areas: adaptive control of single-input single-output systems (Model Reference Control, suboptimal control with on-line identification), stochastic systems, Linear Quadratic (Gaussian) control and state estimation, predictive control of multi-input multi-output systems

Requirements on student

Working-out of dated up work
Exam

Content

Adaptive control of single-input single-output systems.
Model Reference Control, Gain Scheduling, suboptimal control with on-line identification.
Linear Quadratic (Gaussian) control and state estimation.
Control of multi-input multi-output linear systems.
Predictive Control based on state space model.

Prerequisites - other information about course preconditions

Knowledge of differential calculus, linear algebra and basic of process control is needed.
Knowledge of MATLAB/SIMULINK is needed.

Competences acquired

Students get knowledge about design of adaptive control and MIMO linear systems control.

Guarantors and lecturers

- **Guarantors:** doc. Ing. František Dušek, CSc.

Literature

- **Recommended:** ASTRÖM, K. J.; WITTENMARK, B. *Adaptive Control. Addison-Wesley Publishing, 1995.*
- **Recommended:** OGATA, K. *Discrete-Time Control Systems. Prentice Hall, 1995.*.
- **Recommended:** CAMACHO, E. F., BORDONS, C. *Model Predictive Control. Springer Verlag, 1999.*.
- **Recommended:** OGATA, K. *Modern Control Engineering. Prentice Hall, 1990.*.

- **Recommended:** HAVLENA, V.; ŠTECHA, J. *Moderní teorie řízení. Vydavatelství ČVUT, Praha, 2000.*
- **Recommended:** Maciejowski, J. M. *Predictive Control with Constrains. 2002, Pearson Education Ltd., Essex.*

Teaching methods

Work with text (with textbook, with book)
Methods of individual activities

Assessment methods

Oral examination
Home assignment evaluation

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Povinně volitelné	B		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Povinně volitelné	B		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Povinně volitelné	B		
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Povinně volitelné	B		

Course description

Department/Unit /	KE / IDSZS			**Academic Year**	2013/2014
Title	Advanced signal processing methods			**Type of completion**	Zkouška
Long Title	Advanced signal processing methods				
Accredited/Credits	Yes, 0 Cred.			**Form of examination**	Combined
Number of hours					
Occ/max	Status A	Status B	Status C	**Course credit prior to**	NO
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	NO
Winter semester	0 / -	0 / -	0 / -		not determined
Language of instruction	Czech, English			**Repeated registration**	NO
Substituted course	!Žádný			**Semester taught**	Winter, Summer
Preclusive courses	N/A				
Prerequisite courses	N/A				
!Předměty informativně doporučené	N/A				

Course objectives:

The aim of the course is to acquaint students with modern methods of signal processing.

Requirements on student

Exam prerequisites:
Attendance at seminar
Submitting Protocols of exercises and teacher approval
Submitting the results of computer exercises and teacher approval

Test conditions
The test consists of written and oral.

Content

The content of the course are the following chapters: Random signals - characteristics of random signals in time and frequency domain.
Estimates of random and nenáhodných parameters. Cramer-Raova limit.
Formalized filtering and restoration of signals. Wiener filtering for continuous and discrete time.
Kalman filtering for continuous and discrete time, its use for modeling system
Adaptive filtering and identification. Adaptive filtering algorithms. Parametric methods of signal processing.
Time-frequency analysis, wavelet transform - a principle used for processing and compression of signals.
Multidimensional signals and spectra, selected integral transformation (Hadamard, Walsh, Haar wavelet transform and 2D).
Nonparametric methods for signal processing - analysis of eigenvalues and vectors of correlation matrices, the signal degradation and noise subspace, the chosen methods. Selected applications - identifying the direction of arrival of signals, frequency analysis with high resolution.

Prerequisites - other information about course preconditions

Advanced Signal Processing

Competences acquired

Advanced Signal Processing

Guarantors and lecturers

- **Guarantors:** doc. Ing. Aleš Filip, CSc.

Literature

- **Recommended:** CASTLEMAN K. R.:. *Digital Image Processing*. Prentice-Hall, New Jersey, USA, 1996.
- **Recommended:** MARPLE, S. L, Jr.:. *Digital spectral analysis with applications.*. Englewood Cliffs, Prentice-Hall, Inc., New York, 1987.
- **Recommended:** KAY, S. M.:. *Fundamentals of Statistical Signal Processing - Detection Theory*. Prentice Hall, 1993.
- **Recommended:** KAY, S. M.:. *Fundamentals of Statistical Signal Processing - Estimation Theory*. Prentice Hall, 1993.
- **Recommended:** KAY, S. M.:. *Modern Spectral Estimation: Theory and Application.*. EngleWood Cliffs, New Jersey: Prentice-Hall, 1988.
- **Recommended:** MADISETTI, V. K., WILLIAMS, D. B. (ed.):. *The Digital Signal Processing Handbook*. USA, CRC & IEEE Press,, 1998.

Teaching methods

Monologic (reading, lecture, briefing)

Assessment methods

Oral examination
Written examination

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		

Course description

Department/Unit /	KRP / IDSSP			**Academic Year**	2013/2014
Title	Continuous Systems Modelling, Simulation			**Type of completion**	Zkouška
Long Title	Continuous Systems Modelling and Simulation				
Accredited/Credits	Yes, 0 Cred.			**Form of examination**	Combined
Number of hours					
Occ/max	Status A	Status B	Status C	**Course credit prior to**	NO
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	NO
Winter semester	0 / -	0 / -	0 / -		not determined
Language of instruction	Czech			**Repeated registration**	NO
Substituted course	!Žádný			**Semester taught**	Winter, Summer
Preclusive courses	N/A				
Prerequisite courses	N/A				
!Předměty informativně doporučené	N/A				

Course objectives:

The aim is to inform students about advanced methods of modeling and simulation of continuous systems. A mathematical description formulation of dynamic systems behavior is based primary on first principles application. The mathematical model is in a form of system of ordinary or partial differential and algebraic equations. The way of mathematical model solving is shown in a part dedicated to simulation. The simulation is a math model numerical solving including restrictions, discreteness, boundary conditions and other real conditions which are significant for given system. All computations are made in MATLAB/SIMULINK environment.

Requirements on student

Working-out of dated up work
Exam

Content

Math models of static and dynamic behavior of mechanical, heat, hydraulic and electric systems
Simulation of dynamic behavior of nonlinear systems describing by ordinary differential and difference equations and containing typical discontinuities

Prerequisites - other information about course preconditions

Basic knowledge of university math and physic courses is needed.
Good knowledge of MATLAB/SIMULINK is needed.

Competences acquired

Students get knowledge about math models building based on first principles method. They will be informed about simulation in MATLAB/SIMULINK environment of nonlinear systems that are described by system of ordinary differential and algebraic equations.

Guarantors and lecturers

- **Guarantors:** doc. Ing. František Dušek, CSc.

Literature

- **Recommended:** ČERMÁK,J. ; PETERKA, V. ; ZÁVORKA, J. *Dynamika regulovaných soustav v tepelné energetice a chemii. ACADEMIA Praha, 1968.*.

- **Recommended:** DUŠEK, F.; HONC, D. *Matlab a Simulink - úvod do používání. Univerzita Pardubice, 2005.*.
- **Recommended:** WOODS, R. L.; LAWRENCE, K. L.:. *Modelling and Simulation of Dynamic Systems. Prentice Hall, 1997.*.
- **Recommended:** Noskievič, P. *Modelování a identifikace systémů*. Montanex a.s., 1999. ISBN 80-7225-030-2.
- **Recommended:** Zítek, P. *Simulace dynamických systémů.*. Ediční středisko ČVUT, Praha, 1983.

Teaching methods

Work with text (with textbook, with book)
Methods of individual activities

Assessment methods

Oral examination
Home assignment evaluation

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		

Course description

Department/Unit /	KST / IDSTP			**Academic Year**	2013/2014
Title	Discrete simulation of technolog. proces			**Type of completion**	Zkouška
Long Title	Discrete simulation of technological processes				
Accredited/Credits	Yes, 0 Cred.			**Form of examination**	Combined
Number of hours					
Occ/max	Status A	Status B	Status C	**Course credit prior to**	NO
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	NO
Winter semester	0 / -	0 / -	0 / -		not determined
Language of instruction	Czech			**Repeated registration**	NO
Substituted course	!Žádný			**Semester taught**	Winter, Summer
Preclusive courses	N/A				
Prerequisite courses	N/A				
!Předměty informativně doporučené	N/A				

Course objectives:

The main goal of the course is to familiarize students with the concepts and approaches, which are applicable to modelling and discrete simulation of operational technological processes.

Requirements on student

The examination is focused on the theoretical principles related to modelling and simulation of technological processes. In addition, it is required to build a real simulation model reflecting technological processes within the frame of selected application domain.

Content

The content of the course is focused mainly on the formalism of coloured Petri nets (hierarchical and non-hierarchical), which is suitable for the construction of models reflecting generalized technological processes. Such models can be properly analyzed, verified and are also ready for the realizations of relevant simulation experiments (reflecting particular input conditions).

Prerequisites - other information about course preconditions

There is expected an intermediate knowledge from the field of modelling and simulation (simulation as an experimental method, architectures and techniques of simulation models, simulation study life cycle, applied mathematical statistics).

Competences acquired

Passing the course supports the skills related to analysis, design and verification of technological processes.

Guarantors and lecturers

- **Guarantors:** prof. Ing. Antonín Kavička, Ph.D.

Literature

- **Recommended:** JENSEN, K. *Coloured Petri nets. Berlin, Springer-Verlag, 1996.*.
- **Recommended:** BANKS, J. *Handbook of simulation & Sons. New York, John Wiley, 1998.*.
- **Recommended:** ZEIGLER, B. P. a kol. *Theory of modeling and simulation. New York, Academic Press, 2000.*.

Teaching methods

Monologic (reading, lecture, briefing)
Dialogic (discussion, interview, brainstorming)

Skills training

Assessment methods

Oral examination
Written examination
Home assignment evaluation

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		

Course description

Department/Unit /	KE / IDSEV			**Academic Year**	2014/2015
Title	Electromagn.and Optical Wave Propagation			**Type of completion**	Examination
Long Title	Electromagnetic and Optical Wave Propagation in Atmosphere and Near the Terrain				
Accredited/Credits	Yes, 0 Cred.			**!Forma zakončení**	Combined
Number of hours					
Occ/max	Status A	Status B	Status C	**Course credit prior to**	NO
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	NO
Winter semester	0 / -	0 / -	0 / -	**Min. (B+C) students**	not determined
Language of instruction	Czech			**Repeated registration**	NO
Substituted course	None			**Semester taught**	Winter, Summer
Preclusive courses	N/A				
Prerequisite	N/A				
Informally recommended courses	N/A				
!Předměty,které předmět podmiňuje	N/A				

Course objectives:

The subject aims to provide students with insight to the theory of electromagnetic and optical wave signal propagation in atmosphere and near the terrain.

Requirements on student

The student is obliged to work out and defend his written report on the assigned topic of the field and to go through an oral examination of selected topics of the subject.

Content

The subject aims to provide students with insight to the theory of electromagnetic and optical wave signal propagation in atmosphere and near the terrain.
Particularly the following topics are included in the course:
"Electromagnetic and optical waves propagation in atmosphere
"Electromagnetic and optical waves propagation in meteorological formations
"Electromagnetic and optical waves propagation near the terrain
"Electromagnetic and optical waves propagation in obstacled arreas - inside buildings and in urban environment
"An ultrawide band signal propagation.

Prerequisites - other information about course preconditions

Electromagnetic theory basics, mathematical calculus at the technical university graduates level

Competences acquired

Understanding of effects in radio and optical waves propagation in various environments and calculations of radio and optical wave propagation in atmosphere, near the terrain and in complicated environments.

Guarantors and lecturers

- **Guarantors:** doc. Ing. Ondřej Fišer, CSc.

Literature

- **Recommended:** Henninger, H.; Wilfert, O,:. *An Introduction to Free-space Optical Communication*. Radioengineering, 2010.
- **Recommended:** Lorrain, P., Corson, D. R., Lorrain, F. *Electromagnetic fields and waves*. New York: W.H. Freeman, 1996.
- **Recommended:** BEZOUŠEK, P., SCHEJBAL, V., ŠEDIVÝ, P. *Elektrotechnika*. Univerzita Pardubice, 2008. ISBN 978-80-7395-101-6.
- **Recommended:** Ramo, S., Whinnery, J. R., Van Duzer, T. *Fields and waves in communication electronics*. Hoboken: John Wiley & Sons, 1994.
- **Recommended:** A.K., Ricklin J. C.:. *Free-Space Laser Communications: Principles and Advances*. Springer, 2010.
- **Recommended:** Johnson, H.; Graham, M.:. *High-speed signal propagation. Advanced black magic*. Upper Saddle River Pearson Education, 2003.
- **Recommended:** Dordova, L.; Wilfert, O.:. *Laser beam attenuation determined by method of available optical power in turbulent atmosphere*. Journal of Telecommunications and Information Technology, 2009.
- **Recommended:** POZAR, D.M. *Microwave engineering*. Hoboken: John Wiley and Sons, 2005.
- **Recommended:** MILLIGAN, T. A. *Modern antenna design*. Hoboken: John Wiley & Sons, 2005.
- **Recommended:** Meeks, M.L. *Radar propagation at low altitudes*. Dedham: Artech House, 1982.
- **Recommended:** ARMAND, N. A., POLYAKOV, V. M.:. *Radio Propagation and Remote Sensing of the Environment*. CRC Press, 2005.
- **Recommended:** SIZUN, H.:. *Radio Wave Propagation for Telecommunication Aplications*. Springer, 2005.
- **Recommended:** SCHEJBAL, V., ČERMÁK, D. *Sbírka příkladů z elektrotechniky*. Pardubice, 2012. ISBN 978-80-7395-567-0.
- **Recommended:** Mazánek, M., Pechač, P.:. *Šíření elektromagnetických vln a antény*. ČVUT, 2008.
- **Recommended:** Prokop, J., Vokurka, J.:. *Šíření elektromagnetických vln a antény. SNTL Praha, 1980.*. Praha, SNTL, 1980.
- **Recommended:** NOVOTNÝ, K. *Teorie elektromagnetického pole I.*. Praha: ČVUT, 2004. ISBN 80-01-01774-5.
- **Recommended:** Coufalová, Havlíček, Mikulec, Novotný, K.:. *Teorie elektromagnetického pole I - Příklady*. ČVUT - FEL, 2000.
- **Recommended:** Mazánek, M., Novotný, K.:. *Vybrané problémy z teorie elektromagnetického pole*. ČVUT, 1993.
- **Recommended:** Novotný, K.:. *Základy optických komunikací*. Baila, 2008.
- **Recommended:** Pechač, P., Zvánovec, S.:. *Základy šíření vln pro plánování pozemních rádiových spojů*. BEN, 2007.

Teaching methods

Dialogic (discussion, interview, brainstorming)
Work with text (with textbook, with book)
Methods of individual activities
Demonstration
Laboratory work

Assessment methods

Oral examination
Home assignment evaluation
Self project defence

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2013	2014	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2013	2014	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2013	2014	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2013	2014	Volitelné	C		

Course description

Department/Unit /	KRP / IDSUI			**Academic Year**	2013/2014
Title	Method of Artificial Intelligence			**Type of completion**	Zkouška
Long Title	Method of Artificial Intelligence (Neural Networks)				
Accredited/Credits	Yes, 0 Cred.			**Form of examination**	Combined
Number of hours					
Occ/max	Status A	Status B	Status C	**Course credit prior to**	NO
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	NO
Winter semester	0 / -	0 / -	0 / -		not determined
Language of instruction	Czech			**Repeated registration**	NO
Substituted course	!Žádný			**Semester taught**	Winter, Summer
Preclusive courses	N/A				
Prerequisite courses	N/A				
!Předměty informativně doporučené	N/A				

Course objectives:

The goal of the subject is to teach the students modern methods how to model static and dynamical properties of the system. Students will learn neural network paradigm, theoretical background and practical implementation.

Requirements on student

Seminar lessons attendance.
Written seminar work.

Content

Introduction. Basic terms and definitions. Historical perspective.
Biological neural network. Biological neuron.
Artificial neural network. Artificial neuron. Percepton.
Neural network learning. Training and testing.
Artificial neural network classification. Neural network types.
Forward, multilayer neural networks.
Forward neural network learning. Backpropagation method.
Static properties modelling of the systems. Creation of the training and testing matrix.
Fuzzy neural networks.
Software for neural networks creation. MATLAB/Neural Network Toolbox.
Practical examples.

Prerequisites - other information about course preconditions

Static and dynamical properties description.
Differential and difference equations solution.
Basics of continuous- and discrete-time modelling of the processes.
Basic knowledge of the computational system MATLAB/Simulink

Competences acquired

Student will be able to create artificial neural networks and realize computationally their learning and implementation.

Guarantors and lecturers

- **Guarantors:** prof. Ing. Ivan Taufer, DrSc.

Literature

- **Basic:** ČSN ISO/IEC 2382-34. *Informační technologie - Slovník - Část 34: Umělá inteligence - Neuronové sítě*. Praha : ČNI, 2001.
- **Basic:** Sinčák, P.; Andrejková, G. *Neurónové siete. Inžiniersky prístup. 1. a 2. diel.*. Košice : elfa, s.r.o., 1996. ISBN 80-88786-42-88.
- **Basic:** Šíma, J.; Neruda, R. *Teoretické otázky neuronových sítí*. Praha : MATFYZPRESS, 1996. ISBN 80-85863-18-9.
- **Basic:** Novák, M.; a kol. *Umělé neuronové sítě, teorie a aplikace.*. Praha : C.H.BECK, 1998. ISBN 80-7179-132-6.
- **Recommended:** FAUSETT, L.V. *Fundamentals of Neural Network: Architectures, Algorithm and Applications*. New Persey : Prentice Hall, 1994.
- **Recommended:** ŠNOREK, M.; JIŘINA, M. *Neuronové sítě a neuropočítače*. Praha : ČVUT, 1996.

Time requirements

Activities	Time requirements for activity [h]
Příprava na zkoušku	20
Účast na výuce	20
Vypracování seminární práce	20
Total:	**60**

Teaching methods

Monologic (reading, lecture, briefing)

Dialogic (discussion, interview, brainstorming)

Assessment methods

Oral examination

Home assignment evaluation

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		

Course description

Department/Unit /	KRP / IDSNR			**Academic Year**	2013/2014
Title	Nonlinear control systems			**Type of completion**	Zkouška
Accredited/Credits	Yes, 0 Cred.			**Form of examination**	Combined
Number of hours					
Occ/max	Status A	Status B	Status C	**Course credit prior to**	NO
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	NO
Winter semester	0 / -	0 / -	0 / -		not determined
Language of instruction	Czech			**Repeated registration**	NO
Substituted course	KRP/IDSIR			**Semester taught**	Winter, Summer
Preclusive courses	N/A				
Prerequisite courses	N/A				
!Předměty informativně doporučené	N/A				

Course objectives:

Cílem předmětu je seznámit s metodami analýzy a syntézy řízení nelineárních systémů, zejm. se zaměřením na algoritmy řízení robotů.

Requirements on student

Examination

Content

Lyapunov theory of stability for autonomous and non-autonomous systems.
Input-output theory of stability. Passive systems.
Feedback linearization.
Mathematical model of a robot manipulator and its properties.
Algorithms of control of robots based on Lyapunov theory of stability, dynamic inversion and exact linearization.
Adaptive and robust control of robots.

Prerequisites - other information about course preconditions

Knowledge of differential and integral calculus, linear algebra and fundamentals of control theory.

Competences acquired

Obtaining knowledge in the area of control of nonlinear dynamic systems, especially robots.

Guarantors and lecturers

- **Guarantors:** doc. Ing. Jan Cvejn, Ph.D.

Literature

- **Recommended:** Marquez H. J. *Nonlinear Control Systems*. Wiley & Sons, 2003.
- **Recommended:** Khalil, H., K. *Nonlinear Systems. 3rd edition.*. Prentice Hall, 2001.
- **Recommended:** Lewis, L. L.; Dawson, D. M.; Chaouki, T. A. *Robot Manipulator Control - Theory and Practice. 2nd edition.*. Marcel Dekker, Inc., 2004.
- **Recommended:** Siciliano, B.; Sciavicco, L.; Villani, L.; Oriollo, G. *Robotics: Modelling, Planning and Control*. Berlin, 2009. ISBN 9781846286414.

Teaching methods

Work with text (with textbook, with book)

Assessment methods

Oral examination

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		

Course description

Department/Unit /	KRP / IDSOR			**Academic Year**	2013/2014
Title	Optimization and Optimal Control			**Type of completion**	Zkouška
Long Title	Optimization and Optimal Control of Technological Processes				
Accredited/Credits	Yes, 0 Cred.			**Form of examination**	Combined
Number of hours					
Occ/max	Status A	Status B	Status C	**Course credit prior to**	NO
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	NO
Winter semester	0 / -	0 / -	0 / -		not determined
Language of instruction	Czech			**Repeated registration**	NO
Substituted course	!Žádný			**Semester taught**	Winter, Summer
Preclusive courses	N/A				
Prerequisite courses	N/A				
!Předměty informativně doporučené	N/A				

Course objectives:

The subject is focused on introduction into basics of deterministic theory of optimal processes and principles of numerical solving extremal tasks with respect to applications in the area of technological processes.

Requirements on student

Examination

Content

Problems of dynamic optimization in discrete time domain - transformation into static optimization problem, Bellman optimality principle. Variational approach to solving problems in continuous domain, necessary and sufficient conditions of the extreme. HBJ equation. Applications for linear systems, LQR controller. Solving problems with contraints on control and state, Pontrjagin maximum principle. Numerical methods of computation of optimal trajectories. Introduction into modern mathematical theory of optimal processes - basics of differential calculus in functional spaces and their applications for obtaining conditions of optimality.

Prerequisites - other information about course preconditions

Knowledge of differential and integral calculus, linear algebra and fundamentals of control theory.

Competences acquired

Obtaining orientation in the basics of deterministic theory of optimal processes and in principles of numerical solving extremal tasks with respect to applications in the area of technological processes.

Guarantors and lecturers

- **Guarantors:** doc. Ing. Jan Cvejn, Ph.D.

Literature

- **Recommended:** Bryson A. E., Ho Y.C. *Applied Optimal Control* . Hemisphere Corp., New York, 1981.
- **Recommended:** Alexejev V. M. a kol. *Matematická teorie optimálních procesů*. Academia, Praha, 1991.
- **Recommended:** Stengel, R. *Optimal Control and Estimation*. Dover Publications, 1994.
- **Recommended:** Kirk, D.E. *Optimal Control Theory: An Introduction*. Dover Publications, 2004.
- **Recommended:** Štecha J. *Optimální rozhodování a řízení*. ČVUT, Praha, 2000.

Teaching methods

Work with text (with textbook, with book)

Assessment methods

Oral examination

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		

Course description

Department/Unit /	KRP / IDSMS			**Academic Year**	2013/2014
Title	Selected Chapters from Math Statistics			**Type of completion**	Zkouška
Accredited/Credits	Yes, 0 Cred.			**Form of examination**	Combined
Number of hours					
Occ/max	Status A	Status B	Status C	**Course credit prior to**	NO
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	NO
Winter semester	0 / -	0 / -	0 / -		not determined
Language of instruction	Czech			**Repeated registration**	NO
Substituted course	!Žádný			**Semester taught**	Winter, Summer
Preclusive courses	N/A				
Prerequisite courses	N/A				
!Předměty informativně doporučené	N/A				

Course objectives:

The application of computer oriented statistical methods in scientific and technical fields enables not only the use of information hidden in data but also the creation of models, optimizations, and possible solutions. It is a multi-disciplinary movement on the frontier of the scientific disciplines of statistics and informatics. The goal of multivariate data processing is to classify data according to many variables and to find hidden structure and interrelationship among these variables. The objective is to find a way of condensing the information contained in a number of original variables into a smaller set of variables with a minimum loss of information. The objective is to classify a sample of entities into a small number of mutually exclusive groups based on the similarities among the entities.

Requirements on student

Self work with statistical software.

Content

Metrology: Introduction to the basics of metrology, statistical estimation parameters position, dispersion and form, calculation uncertainties establish entitlements result.
Character range unit data: Data matrix, objects and variables. Types of variables and multidimensional accidental vector.
Preliminary treatment multidimensional data: Sorts transformation. Centering and standardization data.
Exploratory analysis of multivariate data: Sorts display range multivariate data. Searching of outliers.
Statistical testing of multivariate accidental selections: Estimates parameters position and dispersion. Statistic analysis vector mean value, statistic analysis of covarince matrixes.
Analysis covariance: Interpretation of covariane matrix. Analysis of correlation matrix. Pair correlation coefficient, partial correlation coefficient, multiple correlation coefficient.
Principal components analysis PCA: Characteristics and geometric meaning of the chief component and their reading. Graphic tools PCA. Diagnostics PCA.
Factor analysis FA: Principles of method and progress FA. Model of factor analyses and parameter estimate. Estimation of factor score, rotation factors. Statement of a problem FA and graphic tools. Found solving and achieved tightness fitting. Reading results and naming factors.
Canonical correlation analysis CCA: Principles of method and progress diagnosed CCA. Test of significance canonical correlation. Found solving and achieved tightness fitting.
Discriminant analysis DA: Classification objects. Principles of method, progress DA and range rules. Linear and quadratic discriminating function. Option signs. Adjustment threshold point. Diagram territorial map. Found solving and achieved tightness fitting.
Logistic regression LR: Principles of method and progress logistic regression. Estimates of parameters and their statistical significance and reading. Quality evaluation and found solving and achieved tightness fitting.
Cluster analysis CLU: Principles of cluster analyses. Measurement similarity and distance. Fitness standardization data. Criteria

for appreciation qualities analysis to the clusters, distance and resemblance objects. Hierarchic sequence analysis. Dendrograms hierarchical clustering. Fuzzy clustering. Clustering method nearest centres- medoids. Tightness fitting under the course of construction clusters.
Surveying objects range unit spectrum MDS: Principles of method and progress range unit spectrum. Metric and no metric method MDS. Found solving and achieved tightness fitting.
Correspondence analysis CA: Principles of method and progress of correspondence analyses. Found solving and achieved tightness fitting. Reading results.

Prerequisites - other information about course preconditions

Knowledge basic statistical methods one - dimensional data.

Competences acquired

Independent creativ knowledge of evoluation of really experimental data.

Guarantors and lecturers

- **Guarantors:** doc. Ing. Milan Javůrek, CSc.

Literature

- **Recommended:** MELOUN, M.; MILITKÝ, J. *Kompendium statistického zpracování dat. Praha: Academia (2006), ISBN 80-200-1396-2.*.
- **Recommended:** MELOUN, M.; MILITKÝ, J. *Statistical analysis of experimental data. In press.*.
- **Recommended:** MELOUN, M.; MILITKÝ, J. *Statistická analýza experimentálních dat. Praha: Academia (2004), ISBN 80-200-1254-0.*.
- **Recommended:** HEBÁK, P. a kol. *Vícerozměrné statistické metody (1). Praha: Informatorium, (2004), ISBN 80-7333-025-3.*.
- **Recommended:** HEBÁK, P. a kol. *Vícerozměrné statistické metody (3). Praha: Informatorium, (2007), ISBN 978-80-73333-001-9.*.

Teaching methods

Monologic (reading, lecture, briefing)
Laboratory work

Assessment methods

Oral examination
Home assignment evaluation

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		

Course description

Department/Unit /	KIT / IDSAF			**Academic Year**	2013/2014
Title	Selected Chapters of Applied Physics			**Type of completion**	Zkouška
Accredited/Credits	Yes, 0 Cred.			**Form of examination**	Combined
Number of hours					
Occ/max	Status A	Status B	Status C	**Course credit prior to**	NO
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	NO
Winter semester	0 / -	0 / -	0 / -		not determined
Language of instruction	Czech			**Repeated registration**	NO
Substituted course	!Žádný			**Semester taught**	Winter, Summer
Preclusive courses	N/A				
Prerequisite courses	N/A				
!Předměty informativně doporučené	N/A				

Course objectives:

The aim of the course is to acquaint students with selected areas of modern physics. The course follows the chosen course of Physics I and Physics II, Physics of Semiconductors, oscillations and waves and optics, at the end of the course are given the foundations of quantum physics. The goal is to develop industry knowledge as a prerequisite for independent research work and the management and implementation of experimental work. The aim is also acquiring a synthetic approach to solving physical phenomena.

Requirements on student

Attendance at lectures and tutorials.

Content

Lectures:
Selected parts of the electromagnetic field theory
Maxwell's equations, the total current law, Gauss's law, Faraday's law of electromagnetic induction, continuity equation, application to the conditions.
Energy of electromagnetic radiation, the law of conservation of energy, Poynting vector.
The wave equation, monochromatic waves, Helmholtz equation, the solution in the form of plane waves.
Conductive environment, wave equation in a conductive environment, complex permittivity and refractive index.
Polarization of light.
Reflection and refraction of electromagnetic waves.

Introduction to Quantum Mechanics
Quantum properties of light, wave properties of particles and their manifestations in the experiments. Basic principles of quantum mechanical description of the microparticles.
Time evolution of micro and stationary states. Schrödinger equation. Continuous and discrete energy spectrum, the model illustrated by examples of free particles and particles bound in an infinitely deep rectangular pit Isolated potential.
Qualitative analysis of the most important practical results of the use of Schrödinger equation - tunnel effect, harmonic oscillator, hydrogen atom.
Conduct sets of identical particles, bosons and fermions, the exclusion principle.

The electrical, optical and magnetic properties of substances
Energy spectrum of electrons in the crystal, Schrödinger equation in periodic potential.
Conductors, semiconductors and insulators.
Relationship with the optical properties of solids.
Magnetism of solids.

Prerequisites - other information about course preconditions

Basic knowledges of higher education physics.

Competences acquired

Deepening of selected parts of physics with a focus on solving demanding problems that correspond to doctoral studies.

Guarantors and lecturers

- **Guarantors:** prof. Ing. Simeon Karamazov, Dr.

Literature

- **Recommended:** PURCELL, E. M. *Elektricity and Magnetism, Berkley Physics Course, Vol. 2, Mc Graw Hill, New York, 1965.*.
- **Recommended:** SEDLÁK, B.; ŠTOLL, I. *Elektřina a magnetismus*. Academia Praha, 1993.
- **Recommended:** WILEY, J. and Sons. *Fundamentals of Physics, Inc. 1997*. Prometheus Praha, 2000.
- **Recommended:** RESNICK, R. E., HALLIDAY, D., WALKER, J. *Fundamentals of Physics, 5 or 6th Edition. John Wiley & Sons Publishing Company, ?2001, 1024 pp. ISBN 978-0-471-32000-5.*.
- **Recommended:** BORN, M., WOLF, E. *Principles of Optics, Pergamon Press, New York 1964*.
- **Recommended:** HRIVNÁK, Ľ. a kol. *Teória tuhých látok*. VŠB, 1992.
- **Recommended:** VOTRUBA, V.; MUZIKÁŘ, Č. *Teorie elektromagnetického pole*. NČSAV, 1955.
- **Recommended:** HAŇKA, L. *Teorie elektromagnetického pole*. SNTL Praha, 1975.
- **Recommended:** FEYNMAN, R. P., LEYGHTON, R. B., SANDS, M. *The Feynman Lectures on Physics, vol. 1, 2, Addison - Wesley Publishing Comp., Reading 1964, (or later The Feynman Lectures on Physics). Lecture notes.*.
- **Recommended:** KITTEL, CH. *Úvod do fyziky pevných látek: Celost. vysokošk. učebnice pro stud. matematicko-fyz. a přírodověd. fakult*. Academia Praha, 1985.

Teaching methods

Stimulating activities (simulation, games, drama)

Assessment methods

Oral examination

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		

Course description

Department/Unit /	KST / IDSDS			**Academic Year**	2013/2014
Title	Selected subjects from algor. and struct			**Type of completion**	Zkouška
Long Title	Selected subjects from algorithms and data structures				
Accredited/Credits	Yes, 0 Cred.			**Form of examination**	Combined
Number of hours					
Occ/max	Status A	Status B	Status C	**Course credit prior to**	NO
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	NO
Winter semester	0 / -	0 / -	0 / -		not determined
Language of instruction	Czech			**Repeated registration**	NO
Substituted course	!Žádný			**Semester taught**	Winter, Summer
Preclusive courses	N/A				
Prerequisite courses	N/A				
!Předměty informativně doporučené	N/A				

Course objectives:

The main goal of the course is to familiarize the students with the selected parts of advanced data structures and relevant algorithms, which are applicable to designing and effective implementations of the software solutions utilized within control and information systems.

Requirements on student

The examination is focused on the theoretical principles related to advanced data structures and relevant algorithms. In addition, it is required to implement a software application, which utilizes selected advanced data structures and algorithms.

Content

The content of the course is focused mainly on the basic concepts and applications of advanced data structures and algorithms from the following fields: interval and multi-dimensional searching (k-D trees, priority search trees, interval trees, quad and octal trees, grid files), hash tables (static hash tables, hash files with dynamic hashing) and multi-indexed files (files with dense indices, inverted files).

Prerequisites - other information about course preconditions

There is expected an intermediate knowledge from the field of data structures and algorithms (abstract data types and structures, data structures with linear and hierarchical organization, priority queues, tables/dictionaries, graphs, block-oriented files).

Competences acquired

Passing the course supports the skills related to analysis and effective implementations of the software solutions utilized within control and information systems.

Guarantors and lecturers

- **Guarantors:** prof. Ing. Antonín Kavička, Ph.D.

Literature

- **Recommended:** GOODRICH, M. T.; TAMASSIA, R. *Algorithm Design. Hoboken (NJ), John Wiley & Sons, 2002.*.
- **Recommended:** LEWIS, H. R.; DENENBERG, L. *Data structures and their algorithms. Berkley, Adison-Wesley, 1997.*.
- **Recommended:** CORMEN, H. a kol. *Introduction to algorithms. Boston, MIT Press, 2001.*.

Teaching methods

Monologic (reading, lecture, briefing)
Dialogic (discussion, interview, brainstorming)
Skills training

Assessment methods

Oral examination
Written examination
Home assignment evaluation

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		

Course description

Department/Unit /	KE / IDSMK			**Academic Year**	2013/2014
Title	Signal propagation in mobile communic.			**Type of completion**	Zkouška
Long Title	Signal propagation in mobile communications				
Accredited/Credits	Yes, 0 Cred.			**Form of examination**	Combined
Number of hours					
Occ/max	Status A	Status B	Status C	**Course credit prior to**	NO
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	NO
Winter semester	0 / -	0 / -	0 / -		not determined
Language of instruction	Czech, English			**Repeated registration**	NO
Substituted course	!Žádný			**Semester taught**	Winter, Summer
Preclusive courses	N/A				
Prerequisite courses	N/A				
!Předměty informativně doporučené	N/A				

Course objectives:

The aim of the course is to acquaint students with the theory of signal propagation in a complicated time-varying environment, the movement of the transmitter and receiver.

Requirements on student

Exam prerequisites:
Attendance at seminar
Submitting Protocols of exercises and teacher approval
Submitting the results of computer exercises and teacher approval

Test conditions
The test consists of written and oral.

Content

The content of the course is on the following topics: Propagation of electromagnetic waves near the ground, in the atmosphere and ionosphere (random nature of the spread).
Dissemination of electromagnetic waves in an environment with obstacles - the buildings, inside buildings.
Dissemination ultrasignals.

Prerequisites - other information about course preconditions

Signal propagation in mobile communications

Competences acquired

Signal propagation in mobile communications

Guarantors and lecturers

- **Guarantors:** doc. Ing. Ondřej Fišer, CSc., prof. Ing. Vladimír Schejbal, CSc.

Literature

- **Recommended:** ARMAND, N. A., POLYAKOV, V. M.:. *Radio Propagation and Remote Sensing of the Environment*. CRC Press, 2005.

- **Recommended:** SIZUN, H.:. *Radio Wave Propagation for Telecommunication Aplications*. Springer, 2003.
- **Recommended:** SÝKORA J.:. *Teorie digitální komunikace*. ČVUT Praha, 2005. ISBN 80-01-02478-4.
- **Recommended:** TAYLOR, J. D.:. *Ultrawideband radar technology*. CRC Press LLC, 2001. ISBN 0-8493-4267-8.

Teaching methods

Monologic (reading, lecture, briefing)

Assessment methods

Oral examination
Written examination

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		

Course description

Department/Unit /	KE / IDSDK			**Academic Year**	2013/2014
Title	Theory of digital communicatin			**Type of completion**	Zkouška
Long Title	Theory of digital communicatin				
Accredited/Credits	Yes, 0 Cred.			**Form of examination**	Combined
Number of hours					
Occ/max	Status A	Status B	Status C	**Course credit prior to**	NO
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	NO
Winter semester	0 / -	0 / -	0 / -		not determined
Language of instruction	Czech, English			**Repeated registration**	NO
Substituted course	!Žádný			**Semester taught**	Winter, Summer
Preclusive courses	N/A				
Prerequisite courses	N/A				
!Předměty informativně doporučené	N/A				

Course objectives:

The goal is to make students familiar with the theory of digital modulator, linear and non-linear modulations without memory is memory and theory of optimal income and detection in the basic channel models.

Requirements on student

Exam prerequisites:
Attendance at seminar
Submitting Protocols of exercises and teacher approval
Submitting the results of computer exercises and teacher approval

Test conditions
The test consists of written and oral.

Content

Basic characteristics of the modulator: modulator linearity and non-linearity, stationarity, memory modulator.
Multistate single carrier modulation: PAM, ASK, PSK, APSK, FSK.
Modulation with many carriers: MTM, OFDM.
Basic models of communication channels: additive with AWGN, LTI, nonlinear with AM / AM and AM / PM, a random linear channel.
Optimum receivers and signal detection algorithms: MAP criterion, ML estimation of parameters of the input signal receivers, optimal receiver of the signal space, the correlation receiver. Receiving modulation of memory: Viterbi algorithm. Symbol error probability, the message bit for the different types of modulation. Synchronization, separate sync, ISI, model of a linear channel with discrete-time equalization, linear equalization, MLS equalization, blind equalization, using Viterbi algorithm, nonlinear distortion of AM / AM and AM / PM).

Prerequisites - other information about course preconditions

Digital Communication Theory

Competences acquired

Digital Communication Theory

Guarantors and lecturers

- **Guarantors:** prof. Ing. Pavel Bezoušek, CSc.

Literature

- **Recommended:** COUCH, L.W.:. *Digital and analog communication systems*. Prentice Hall, 2001. ISBN 0-13-081223-4.
- **Recommended:** PROAKIS, J. G.:. *Digital Communication*. McGraw Hill, Inc., 3 rd ed, 1996.
- **Recommended:** KAY, S. M.:. *Fundamentals of Statistical Signal Processing - Detection Theory*. Prentice Hall, 1993.
- **Recommended:** KAY, S. M.:. *Fundamentals of Statistical Signal Processing - Estimation Theory*. Prentice Hall, 1993.
- **Recommended:** SÝKORA, J.:. *Teorie digitální komunikace*. ČVUT Praha, 2005. ISBN 80-01-02478-4.

Teaching methods

Monologic (reading, lecture, briefing)

Assessment methods

Oral examination
Written examination

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		

Course description

Department/Unit /	KE / IDSTA			**Academic Year**	2014/2015
Title	Theory of Microwave Antennas			**Type of completion**	Examination
Accredited/Credits	Yes, 0 Cred.			**!Forma zakončení**	Combined
Number of hours					
Occ/max	Status A	Status B	Status C	**Course credit prior to**	NO
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	NO
Winter semester	0 / -	0 / -	0 / -	**Min. (B+C) students**	not determined
Language of instruction	Czech			**Repeated registration**	NO
Substituted course	None			**Semester taught**	Winter, Summer
Preclusive courses	N/A				
Prerequisite	N/A				
Informally recommended courses	N/A				
!Předměty,které předmět podmiňuje	N/A				

Course objectives:

The subject aims to provide students with insight to the microwave antennas theory and design methods including numerical simulations and measurement. The acquired theoretical knowledge are then applied on individual microwave antenna systems using a systematic approach.

Requirements on student

The student is obliged to work out and defend his written report on the assigned topic of the field and to go through an oral examination of selected topics of the subject.

Content

Mainly the following topics are addresed:
"Irradiating structures and numerical Irradiatimethods
"Antenna arrays
"Field distribution in the antenna aperture and diagram synthesis
"Irradiation elements: dipoles, slots, loops, patches, horns
"Reflector antennas
"Microwave lenses
"Forward waves antennas
"Frequency nonselective antennas
"Phased arrays

Prerequisites - other information about course preconditions

Electromagnetic theory basics, mathematical calculus at the technical university graduates level

Competences acquired

Understanding of principles of analysis and methods of synthesis of various microwave antennas. Analysis and design of various types of microvawe antennas.

Guarantors and lecturers

- **Guarantors:** prof. Ing. Vladimír Schejbal, CSc.

Literature

- **Recommended:** JOHNSON, R.C. *Antenna engineering handbook*. New York: McGraw-Hill, 1993.
- **Recommended:** P. Lorrain a kol. *Electromagnetic fields and waves*. W. H. Freeman. N. York, 1996.
- **Recommended:** Ramo, S., Whinnery, J. R., Van Duzer, T. *Fields and waves in communication electronics*. Hoboken: John Wiley & Sons, 1994.
- **Recommended:** POZAR, D.M. *Microwave engineering*. Hoboken: John Wiley and Sons, 2005.
- **Recommended:** MILLIGAN, T. A. *Modern antenna design*. Hoboken: John Wiley & Sons, 2005.
- **Recommended:** TAYLOR, J. D.:. *Ultrawideband radar technology*. CRC Press LLC, 2001. ISBN 0-8493-4267-8.

Teaching methods

Dialogic (discussion, interview, brainstorming)
Work with text (with textbook, with book)

Assessment methods

Oral examination

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2013	2014	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2013	2014	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2013	2014	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2013	2014	Volitelné	C		

Course description

Department/Unit /	KE / IDSRS			**Academic Year**	2013/2014
Title	Theory of modern radar systems			**Type of completion**	Zkouška
Long Title	Theory of modern radar systems				
Accredited/Credits	Yes, 0 Cred.			**Form of examination**	Combined
Number of hours					
Occ/max	Status A	Status B	Status C	**Course credit prior to**	NO
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	NO
Winter semester	0 / -	0 / -	0 / -		not determined
Language of instruction	Czech, English			**Repeated registration**	NO
Substituted course	!Žádný			**Semester taught**	Winter, Summer
Preclusive courses	N/A				
Prerequisite courses	N/A				
!Předměty informativně doporučené	N/A				

Course objectives:

The aim of the course is to introduce the theory and methods of measurement generalized location of foreign objects, systems, active and passive radar and principles of statistical signal processing in radar.

Requirements on student

Exam prerequisites:
Attendance at seminar
Submitting Protocols of exercises and teacher approval
Submitting the results of computer exercises and teacher approval

Test conditions
The test consists of written and oral.

Content

Principles of radar systems: primary radar, secondary radar, passive radar, bistatické, multistatické.
Distance measurement of the position angle and velocity using electromagnetic waves: resolution, clarity and accuracy.
Scattering of electromagnetic waves on objects: the classification of objects, description of the variance, the statistical properties of scattering and implications for the detection of objects.
Influence of electromagnetic waves propagation in the atmosphere, the ionosphere, in the presence of obstacles and terrain characteristics of the radar systems.
Radar equation: basic equation, the equation of a limited range of noise, veil, cover and search equation: derivation, consequences.
Radar systems: primary radar coherent and incoherent (HPRF, LPRF, LPI), secondary radar (ATC, SAR), passive radar coherent and incoherent (TOA, TDOA, DOA, Doppler., PCL), bistatické, multistatické.
Customized filtering and pulse compression, the function of uncertainty of radar signals.
Doppler filtering, detection, CFAR.
Association and the monitoring of targets and trajectories, Kalman filtering, the issue many goals - startup, PHD method, model search multičásticový position of many goals.

Prerequisites - other information about course preconditions

Theory of modern radar systems

Competences acquired

Theory of modern radar systems

Guarantors and lecturers

- **Guarantors:** prof. Ing. Pavel Bezoušek, CSc.

Literature

- **Recommended:** GALATI, G., et al.:. *Advanced radar techniques and systems*. Peter Peregrinus, Ltd.,, 1993. ISBN 0-86341-172-X.
- **Recommended:** WILLIS, N. J., GRIFFITHS, H. D.:. *Advances in Bistatic Radar*. Scitech Publishing, Inc., 2007. ISBN 1891121480.
- **Recommended:** SHEER, J. A., KURTZ, J. L.:. *Coherent radar performance estimation*. Artech House, 1993. ISBN 0-89006-628-0.
- **Recommended:** KAY, S. M.:. *Fundamentals of Statistical Signal Processing - Detection Theory*. Prentice Hall, 1993.
- **Recommended:** KAY, S. M.:. *Fundamentals of Statistical Signal Processing - Estimation Theory*. Prentice Hall, 1993.
- **Recommended:** BARTON, D. K.:. *Modern radar system analysis, Artech house*. 1988. ISBN 0-89006-170-X.
- **Recommended:** NATHANSON, F. E.:, REILLY, J. P., COHEN, M. N.:. *Radar design principles, signal processing and the environment*. 2nd edition, 1999. ISBN 1-891121-09-X.
- **Recommended:** BEZOUŠEK, P., ŠEDIVÝ, P.:. *Radarová technika*. null. ČVUT Praha, 2. vyd., 2007. ISBN 978-80-01-03036-3.
- **Recommended:** STEVENS, M. C.:. *Secondary surveillance radar*. Artech House. ISBN 0-89006-292-7.

Teaching methods

Monologic (reading, lecture, briefing)

Assessment methods

Oral examination
Written examination

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Full-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		
Electrical Engineering and Informatics	Doctoral	Part-time	Information, Communication and Control Technologies	1	2011	2013	Volitelné	C		