Recomended pass through the study plan

Name of the pass: Doctoral study block, daily study

Faculty/Institute/Others: Faculty of Electrical Engineering
Department:
Pass through the study plan: Doctoral studies, daily studies
Branch of study guranteed by the department: Welcome page
Guarantor of the study branch:
Program of study: Electrical Engineering and Information Technology
Type of study: Doctoral full-time
Note on the pass: ~Každý student si volí rozložení předmětů do semestrů individuálně.

Coding of roles of courses and groups of courses:
P - compulsory courses of the program, PO - compulsory courses of the branch, Z - compulsory courses, S - compulsory elective courses, PV - compulsory elective courses, F - elective specialized courses, V - elective courses, T - physical training courses

Coding of ways of completion of courses (KZ/Z/ZK) and coding of semesters (Z/L):
KZ - graded assesment, Z - assesment, ZK - examination, L - summer semester, Z - winter semester

Number of semester: 1

Code	Name of the course / Name of the group of courses *(in case of groups of courses the list of codes of their members)* *Tutors,* ***authors*** *and guarantors (gar.)*	Completion	Credits	Scope	Semester	Role
PKKPPP	**Předměty doktorského studia** *XP02AME,XP02AMA,..... (see the list of groups below)*	Min. cours. 0	Min/Max 20/30			S

List of groups of courses of this pass with the complete content of members of individual groups

Kód	Name of the group of courses and codes of members of this group (for specification see here or below the list of courses)	Completion	Credits	Scope	Semester	Role
PKKPPP	**Předměty doktorského studia**	**Min. cours. 0**	**Min/Max** 20/30			**S**

XP02AME	Active Methods in Acoustics	XP02AMA	Active Methods in Acoustics	XP37AEM	Acoustic and Electroacoustic Mea ...
XP37APF	Acoustics and Electroacoustics o ...	XP37AR	Speech Acoustics	XP31ASN	Algorithms and Structures of Neu ...
XP34AIC		XP31AEO	Electric Circuit Analysis	XP04A2SZK	English Language
XP04AZK	English Language	XP04MIN	English Language 2	XP04A1ZK	English language 1
XP04A1	English language 1	XP04A2	English language 2	XP04A2ZK	English language 2
XP34AT	TCAD Tools Applications	XP37AEA	Applied Electroacoustics	XP32AKR	Applied Cryptography
XP17APL	Applied Optoelectronics in Medic ...	XP36ASP	Architecture of Symbolic Compute ...	XP37ARA	Architectural Acoustics
XP31ART	Architectures for Real Time Impl ...	XP38ATM		XP02BFY	Biophysics
XP33BID	Bionics	XEP33CML	Computational Intelligence Techn ...	XEP35CMS	Computational Methods for Materi ...
XP04Č1	Czech language 1	XP04C1ZK	Czech language 1	XP04C2ZK	Czech language 2
XP04Č2	Czech language 2	XP31DSP	Digital signal processing	XP31CZS	Digital signal processing
XP33RG2	Reading Group	XP33RCV	Reading group in Pattern Recogni ...	XP13DFD	Data and Functional Analysis of ...
XP13DEZ	Degradation processes of electri ...	XP16HPH	History of Physic	XP34ORD	Optical Radiation Detection and ...
XP36DRO	Diagnostics and Reconfiguration ...	XP34DTM	DIAGNOSTICS AND TESTING IN MICRO ...	XP15DVN	Diagnostics of HV and EHV Insula ...
XP02DP	Electric Discharges and their Ap ...			XP32DZS	Digital Signal Procesing in Tele ...
XP32DKS	Sizing of communications network ...	XP13DTF	Thin film diagnostics	XP36DSV	Distributed Systems
XP36DSY	Distributed Systems	XP33DID	Distributed Artificial Intellige ...	XP14DSD	Dynamics of Electric Machines
XP14DES	Dynamics of Electric Machines	XP37DRS	Satellite communication and navi ...	XP01EAL	Effect algebras
XP01EKM	Mathematics Models for Economics	XP16EES	Economics of energy systems	XP16EKO	Economics
XP16MES	Economics and Management of Ener ...	XP16ERU	Accounting	XP16MEU	Economics and Management of Ener ...
XP16EPM	Economics of power markets	XP16EME	Economics and Management of Ener ...	XP37ELA	Elastoacoustics
XP15ES	Electrical Lighting	XP16ERE	Economics of power generation fr ...	XP02EVA	Physics for Electroenergetics
XP34ETS	Electrical Transport in Semicond ...	XP15ET	Electroheat	XP14EMC	Electromagnetic Compatibility
XP14ECD	Electromagnetic Compatibility	XP17ELD	Electrodynamics	XP15EH	Energy Economy
XP15EZP	Control in Power Engineering	XP38EMC	Electromagnetic Compatibility of ...	XP15EXE	Expert Systems in Electrical Pow ...
XP16FVT	Philosophical Problems of Scienc ...	XP33ECD	Evolutionary Computing	XP31FSK	Phonetic signals and their codin ...
XP31FON	Speech Phonetics and Advanced Vo ...	XP16FIM	Financial Management	XP37FOS	Photonic Imaging Systems
XP13FCD	Photovoltaics systems	XP15FAK	Photometry and Colorimetry	XP04F1	French language 1
XP04F2ZK	French language 2	XP04F1ZK	French language 1	XP01FA1	Functional Analysis 1
XEP33FLO	Fuzzy Logic	XP04F2	French language 2	XP35FMD	Fuzzy Modelling and Control
XP35FMC1	Fuzzy modeling and control	XP33FLO	Fuzzy Logic	XP37PAC	Physiological Acoustics

XP13FDD	Physic of Dielectrics	XP37FZS	Fuzzy Signal Processing	XP34ASD	Physics of Advanced Semiconducto ...
XP13FPD	Semiconductor Physics	XP02FPL	Solid State Physics	XP37FHA	Physiological, Psychological and ...
XP37FHA1	Physiological, Pychologycal and ...	XP02FPT	Physics for Therapy	XP37GAB	Genesis and Analysis of Biosigna ...
XP33GAD	Geometrical Algebras	XP37FHA2	Physiological, Psychological and ...	XP16HKA	Historical structures and techno ...
XP16HDS	History of Transport Systems and ...	XEP33GMM	Graphical Markov Models	XP16HIS	Historiography of the Developmen ...
XP02HS	Noise Surveys	XP16HEL	History of Electrical Engineerin ...	XP37IAR	Implementation algoritms in radi ...
XP33IMD	Informatics in Clinical Medicine	XP36HS	Hypermedia Systems and Internet ...	XP34IO	Integrated Optics
XP12IMM	Engineering Methods in Mechanics	XP01ITZ	Integral Transforms and Z Transf ...	XP33CHM	Chapters in higher mathematics
XP01KAS	Complexity and Combinatorical Al ...	XP36JAI	Languages for Artificial Intelli ...	XP35CCM1	Cooperative control of multi-age ...
XP34CNO	Integrated Optics	XP36KP	Communication Protocols	XP16ECM2	Quantitative research methods in ...
XP16KVM	Quantitative Research Methods in ...	XP16ECM1	Quantitative research methods in ...	XP17LAE	Medical Applications of Electrom ...
XP37LN	Aircraft Navigation	XP01KVP	Quantum Computing	XP35LMI1	Linear matrix inequalities
XP35LSD	Linear Systems	XP35LMI	Linear Matrix Inequalities	XP33LPD	Logic and Logic Programming
XP38MPX	Magnetism in Engineering Practic ...	XP36LSM	Logical Simulation	XP16MAN	Management
XP16MAV	Production Management	XP02MHD	Magnetohydrodynamics	XP16MAU	Accounting for management
XP16MAR	Marketing	XP33MZT	Management of Knowledge and Info ...	XP33MAD	Mathematical Analysis of Dempste ...
XP01MST	Mathematical Statistics	XP16MAS	Marketing Strategies	XP01MKR	Mathematics for cryptography
XP33MKD	Mathematics for Cybernetics - Se ...	XP01MTS	Mathematical Methods in Signal T ...	XP01MTP	Matrix Calculus
XP15MPE	Mechatronics in Electrical Power ...	XP34MTP	Materials and Technologies for P ...	XP15MVN	High Voltage Measurement
XP37MVP	Scientific Work Methodology	XP38MMN	Measurement of Nonelectric Quant ...	XP33MMD	Analysis and visualization metho ...
XP17MAPP	Analysis Methods for Passive Ele ...	XP17MVP	Methodology of Science	XP38MPM	Methods for Precision Measuremen ...
XP38MET	Metrology	XP38MDR	Methods of Signals Digitalizatio ...	XP14MIP	Microprocessor Control of Electr ...
XP14MIR	Microprocessor Control of Electr ...	XP14MID	Microprocessor Control of Electr ...	XP34MSA	Microsystems and Microactuators
XP17MT	Microwave Technique	XP34MSY	Microsystems	XP33MOL	Modal Logics for Distributed Sys ...
XP13MSD	Modelling and Simulation of Tech ...	XP32MOS	Mobile Networks	XP02MPF	
XP14RPD	Advanced Controlled Drives	XP33ICT	Modern ICT for Industry and Smar ...	XP14MRP	Advanced Controlled Drives
XP37MSC	CNS Modern Systems	XP14MPO	Advanced Controlled Drives	XP14MZR	New Control Methods for Electric ...
XP14MPD	Advanced Control Methods of Elec ...	XP34APD	Advanced Power Semiconductor Dev ...	XP37NAV	Navigation systems
XP31NOS	Design and circuit structures of ...	XP37MPS	Multimedia Signals Transmission	XP34PIC	Programmable IC Design
XP37NRO	CAD for RF and Microwave Circuit ...	XP31DIF	Digital filter synthesis	XP35NES	Nonlinear Systems
XP04N1	German language 1	XP35NES1	Nonlinear systems	XP04N2ZK	German language 2
XP04N2	German language 2	XP04N1ZK	German language 1	XEP33NEP	Neuroprosthetics
XP13NM	New Matherials and their Applica ...	XP36NSN	Neural Networks and Neurocompute ...	XP14MTD	New Trends in Converter Technolo ...
XP14APR	New Trends in Electric Device Ap ...	XP14MEN	New Trends in Converter Technolo ...	XP14APD	New Trends in Electric Device Ap ...
XP14NTP	New Trends in Electric Device Th ...	XP14NAP	New Trends in Electric Device Ap ...	XP14TPD	New Trends in Electric Device Th ...
XEP33NUM	Numerical Analysis	XP14TPR	New Trends in Electric Device Th ...	XP01NLA	Numerical Linear Algebra
XP32NMR	Numerical Methodes of Electromag ...	XP33NUM	Numerical Analysis	XP34EHA	Renewable Energy Microsources fo ...
XP37IPP	Image Processing and Photonics	XP17NME	Numerical Methods in Electromagn ...	XP35OFD	Estimation and Filtering
XP35ESF1	Estimation and filtering	XP32ODV	Intellectual property protection	XP37ODS	Optical Design and Simulation
XP17OV	Optical Fibers	XP33OSD	Real Time Operating Systems	XP35ORC1	Optimal and robust control
XP36PSV	Parallel Systems and Algorithms	XP32OSY	Optical Systems	XP34PED	Advanced Electronic Devices
XP13PED	Plastics in Electrical Engineeri ...	XP01PDR	Partial Differential Equations	XP33VTP	Computer Vision Theory and Prac ...
XP01POA	Advanced theory of operator alge ...	XP02PT	Plasma Technologies	XEP36AGT	Advanced Computational Game Theo ...
XP37CAD	Advanced methods for circuit ana ...	XP39CG	Advanced Computational Geometry	XP39UID	Advanced methods of UI design
XP39VIZ	Advanced Visualization Methods	XP16AFM	Advanced Financial Management Me ...	XP36POA	Advanced Parallel Algorithms
XP37NOS	Advanced Computational Tools for ...	XP39PMV	Advanced Methods of Visualizatio ...	XP17PEM	Advanced Electromagnetism
XP34SDS	Semiconductor Structures	XP37MSP	Advanced Multimedia Signal Proce ...	XP33PPD	Practical Data Mining Problems
XP33PAD	Probabilistic Algorithms	XP34SRS	Semiconductor Radiation Sources	XP34ADM	Principles and Applications of D ...
XP37PKP	Biomedical Engineering in Clinic ...	XP33PMD	Probabilistic Models of Uncertai ...	XP33PAM	Industrial application of multi- ...
XP13PSD	Flexible Production Systems	XP36PAS	Algebraic Specifications Prototy ...	XP38PSL	Aircraft Instrumentation
XP38PUC		XP15PEE	Transmission of Electricity	XP36RSY	Reconfigurable Systems
XP35RRD	Robust Control	XP37RAD	Radioelectronics	XP33ROD	Pattern Recognition
XP04R1	Russian language 1	XP33RSK	Robust Statistics for Cybernetic ...	XP04R2ZK	Russian language 2
XP04R2	Russian Language 2	XP04R1ZK	Russian language 1	XP35FSC	Flexible Structure Control
XP16JAK	Quality Management	XP35FSC1	Flexible structures control	XP35CCM	Cooperative Control of Multi-age ...
XP33RSP	Management of Software Projects	XP33RMD	Control of Mobile Robots	XP15RE	Control of Power Systems
XEP17SWR	Scientific Writing	XP32RTS	Telecommunications Systems Manag ...	XP15SPS	Coupled Problems in Heavy Curren ...
XEP33VKR	Selected Topics in Pattern Recog ...	XPE04SCWR	Scientific Writing	XP39SCG	Seminar in Comnuter Graohics
XP39SPG	Computer Graphics Seminar	XP01SPJ	Syntax and semantics of a formal ...	XP38SSB	Sensors and Buses
XP38SSA		XP36SEP	Seminars on Architectures of Par ...	XP13SSD	Special Methods of Devices Quali ...
XP37SRP	Radio Receivers Special Technolo ...	XP13SID	Software in Industrial Engineeri ...	XP02SF	Statistical Physics
XP37SZS	Statistical Signal Processing	XP13SAV	Statistic analysis and technolog ...	XP16STV	Product Strategy
XP36STR	Stringology	XP16SDE	Building heritage of the industr ...	XP34STV	VLSI Structures and Technologies
XP15ZSS	Light sources and Equipment	XEP33SML	Structured Model Learning	XP33SDD	Discrete Event Systems
XP38SYS	Measurement and Data Acquisition ...	XP33SCD	Man-Machine Systems	XP13SJD	Quality Control Systems
XP04S1ZK	Spanish language 1	XP13SRD	Real Time Systems for Process Co ...	XP04S2ZK	Spanish language 2
XP04S2	Spanish language 2	XP04S1	Spanish language 1	XP13TND	Technology of Low Temperatures a ...
XP17TVC	Technique of Highly Sensitive Re ...	XP37TMP	Medical Instrumentation	XP13TPD	Technological Processes in Elect ...
XP34TOS	Technology of Optical Devices	XP13TMD	Technological Aspects of Microco ...	XP37TEM	Theoretical Electroacoustics and ...
XP02TF1	Theoretical Physics 1	XP37TEA	Theoretical Eletroacoustics	XP17TOM	Theoretical Optoelectronics in M ...
XP37RUP	Radio determination of position, ...	XP02TF2	Theoretical Physics 2	XP01TGR	Graph Theory
XP01TJA	Languages, Automata and Grammars	XP37TAS	Acoustic signal processing and t ...	XP32TPZ	Teletraffic Theory
XP31TSS	Signal and system theory	XP15TOS	Theory of Light field	XP17TAM	Evaluation of Applicators for Mi ...

XP33TTM	Text mining	XP02TZP	Theory of Sound Field	XP33UID	Artificial Intelligence
XP01UAG	Introduction to Algebraic Geomet ...	XP02UZ	Ultrasound and Quantum Acoustics	XP02UFL	Introduction to Laser Physics
XP37ISS	Introduction to space science an ...	XP02UEF	Introduction to Electrophysiolog ...	XP01UNA	An introduction to nonassociativ ...
XP01USA	An introduction to superalgebras ...	XP01UKS	Introduction to Quantum Structur ...	XP13VTK	Vacuum technology and cryogenics
XP16HKC	Science, Technics and Technology ...	XP15UEE	Electric Energy Use and Conserva ...	XP37VRA	Research Seminars in Radioelectr ...
XP16VPB	Science, Technology and Industri ...	XP16VTK	Everyday Science and Technology	XP02VNP	Plasma Waves and Instabilities
XP16DEL	History of technology and econom ...	XP39VR	Virtual reality	XP37FOT	Selected Parts from Photonics
XP38VKP	Selected Parts of Instrumentatio ...	XP37VKF	Selected Parts from Photonics	XP33KSI	Sotware Engineering - Selected c ...
XP38VKZ	Selected Chapters of Signal Proc ...	XP01TEM	Selected chapters of the measure ...	XP36VPD	Selected Parts of Data Mining
XP01VPS	Selected topics in probability a ...	XP38VDI	Selected Chapters of Diagnostics	XP17ANS	Selected Chapters from Antennas ...
XP02VPA1	Selected Topics of Physics 1	XP33PUD	Artificial Intelligence	XP02VPB	Selected Topics of Physics B
XP02VPO	Selected Topics of Optics	XP02VPA2	Selected Topics of Physics B	XP16MVE	Selected Problems of Economy and ...
XP37SFA	Fundamentals of Physical Acousti ...	XP33ROZ	Selected Topics in Pattern Recog ...	XP36VAV	
XP39VPG	Computational Geometry	XP16STM	Selected Statistical Methods	XP12VVM	Development and Research of Mate ...
XP13VVM	Development and Research of Mate ...	XP36VAP	Advaced Computer Architecture	XP13VNM	Research of new materials
XP15VME	Research Methods in th Use of El ...	XP16VTS	Development of Technical Univers ...	XP33KHD	Introduction to Game Theory
XP33ZPM		XP02ZFP	Fundamentals of the Plasma Physi ...	XP33POS	Fundamentals of Possibilistic Me ...
XP33TPS	Foundations of the Possibilistic ...	XP33ZVD	Introduction to Computer Vision	XP16ZVP	Fundamentals of Scientific Work
XP01ZWT	Wavetet Transform.	XP01ZOA	Fundamentals of the theory of op ...	XP34RSD	Radiation Saurces and Photodetec ...
XP33ZDD	Processing of Biological Data	XP37ZI	Information recording	XP37ZSN1	Signal processing in satellite n ...
XP37ZSN2	Signal processing in satellite n ...	XP31ZBS	Biological Signal Processing		
		XP33VID	3D Computer Vision		

List of courses of this pass:

Code	Name of the course	Completion	Credits
XEP17SWR	Scientific Writing	ZK	4
This course is intended to help researchers organize and effectively communicate, in English, their scientific results. While the instructor is an Electrical Engineer, the approaches are applicable to all technical disciplines.			
XEP33CML	Computational Intelligence Techniques for Machine Learning	Z,ZK	4
Learning objective:become familiar with the theory and applications of computational intelligence methods in the context of systems capable of learning from data. Introduction, motivation for learning, computational intelligence. Supervised, unsupervised and reinforcement learning paradigms. Fuzzy systems, neural networks, neuro-fuzzy systems, and other general function approximators for supervised learning. Fuzzy clustering methods for unsupervised learning. Reinforcement learning for single-agent and multi-agent systems. Examples of applications and case studies. The course will be connected with - a computer assignment with Matlab/Simulink and a literature assignment.			
XEP33FLO	Fuzzy Logic	ZK	4
Basics of fuzzy sets and fuzzy logic. Measures on collections of fuzzy sets. Principles of fuzzy control.			
XEP33GMM	Graphical Markov Models	ZK	4
The course was taught in WS 2023/24 for the last time. It will not be opened anymore. Markov models on graphs represent a model class widely applied in many areas of computer science, such as computer networks, data security, robotics and pattern recognition. The first part of the course covers inference and learning for Markov models on chains and trees. All these tasks including structure learning can be solved by efficient algorithms. The second part addresses graphical models on general graphs. Here on the contrary, practically all inference and learning tasks are NP-complete. The focus is therefore on efficient approximative algorithms.			
XEP33NEP	Neuroprosthetics	Z,ZK	4
Neuroprosthetics is concerned with the use of artificial devices to replace or improve the function of the human nervous system. The neuroprosthetic device in most widespread use is the cochlea implant with approximately 150,000 in use worldwide. In this course we will look at the different technologies involved, particularly in terms of implant construction and materials and their practical use. We will also see how such implants interact with the human nervous system, forming a bidirectional gateway both to monitor signals on the nervous system and to directly stimulate the human brain.As well as witnessing the exciting development of the field we will consider neuroprosthetics in terms of practical restorative use, not only in Cochlea implants but also for visual and motor repair. We will however also look at the possibilities of Neuroprosthetics for general human enhancement and investigate how the presenters own self experimentation fits into teh field. Whilst the course will focus on technical issues, it will be presented in a general way such that all students should be able to follow (i.e. a mathematical background is not a requirement). Indeed as this technology has immediate impact, societal, ethical and moral issues raised will also be discussed. The course is complementary to the lecture course given on Bionics: this set of lectures being specifically concerned with neural aspects - linking the human brain and nervous system with technology.			
XEP33NUM	Numerical Analysis	Z,ZK	4
The course introduces to basic numerical methods of interpolation and approximation of functions, numerical differentiations and integration, solution of transcendent and (ordinary and partial) differential equations and systems of linear equations. Emphasis is put on estimation of errors , practical skills with the methods and demonstration of their properties using Maple and computer graphics.			
XEP33SML	Structured Model Learning	ZK	4
This advanced machine learning course covers learning and parameter estimation for structured models like Markov Random Fields, Belief Networks and (stochastic) Deep Neural Networks.			
XEP33VKR	Selected Topics in Pattern Recognition and Computer Vision	ZK	4
The course deals with fundamental results from computer vision and pattern recognition. The course treats selected key results, as well as latest areas of research, especially those which substantially influence the development in the subject field. Education is performed in the form of a reading group. The course is mainly targeting PhD candidates, but is also available for Msc students with strong interest, possibly experience too, on a research topic that is relevant to the course.			
XEP35CMS	Computational Methods for Materials Science	Z,ZK	4
The final goal of the course is to acquire advanced knowledge of Classical and Quantum Mechanics to design in-silico experiments within the Materials Science field. At the end of the course, the students will know: - the fundaments of thermodynamics, newtonian and statistical mechanics, and how the relative formalism is implemented in order to calculate thermodynamical properties; - how the Schrödinger equation is setup and solved in order to calculate physical quantities; - how to combine the classical and quantum mechanics to			

	model experimental results; and - a general protocol through which to design new materials at the atomic scale. By means of simulation laboratory experience, the students will eventually learn how to setup and run simulations, and how to analyse and present the results by using post-processing softwares.		
XEP36AGT	Advanced Computational Game Theory	ZK	4
XP01EAL	Effect algebras	ZK	4
	Bsic course on effect algebras. Effect algebras, MV-effect algebras, various types of elements, compatibility, partitions, states.		
XP01EKM	Mathematics Models for Economics	ZK	4
	This course is an introduction to the theory of time series and random processes used in economics for describing values (financial assets, product prices, financial loss) randomly developing in time will be shown. Further, the terms of stochastic differential and stochastic integral are introduced.		
XP01FA1	Functional Analysis 1	ZK	4
	Measure theory and Lebesgue integral. An introduction to Hilbert spaces. Theory of linear operators in Hilbert spaces. Spectral theory.		
XP01ITZ	Integral Transforms and Z Transform	ZK	4
	Basic types of integral transforms, linearity. Laplace transform, inversion, limit theorems. Fourier transform. Application to solving integral and differential equations. Introduction to distribution theory, Fourier and Laplace transforms of distributions. Linear dynamic systems, causality, passivity, convolution. Systems with bounded spectrum. Z-transform and difference equations.		
XP01KAS	Complexity and Combinatorical Algorithms	ZK	4
	Time and space complexity of algorithms. P and NP problems and their solutions: exact solutions, heuristics, approximation schemes, probabilistic algorithm. Equivalences of problems.		
XP01KVP	Quantum Computing	ZK	4
	Quantum computing represents a new programming paradigm. The safety of nowadays encypering techniques is based on enormous computation complexity of classical mathematical problems. This safety may be broken by quantum computers. The ``building stones'' of a quantum computer and quantum computers will be developed during the course. We will design fast factorization algorithms, fast database search, etc.		
XP01MKR	Mathematics for cryptography	ZK	4
	Introduction to the theory of groups, finite fields, and polynomials over finite fields and their applications in cryptography.		
XP01MST	Mathematical Statistics	ZK	4
	Random sampling, ordered sampling and their distributions. Sample statistics. Point estimates and interval estimates.Confidence intervals. Estimations, unbiased and consistent estimates. Hypothesis testing for distribution parameters. Hypothesis testing for equality of parameters. Nonparametric tests. Regression analysis.		
XP01MTP	Matrix Calculus	ZK	4
	Similar matrices. Jordan blocks, Jordan canonical matrices. Real canonical form of a real matrix. Characteristic and minimal polynomial. Caley-Hamilton thoerem. Functions of matrices, exponential matrix. Symetric, orthogonal and positive matrices. Diagonalization of symetric, positive and circulant matrices. Singular value decomposition. Moore-Penrose pseudoinverse matrix. Generalized solution of systems of linear equations.		
XP01MTS	Mathematical Methods in Signal Theory	ZK	4
	Continuous, discrete, periodic and almost periodic signals. Fourier series and Fourier integral. Band-limited signals. Theorems of Paley-Wiener and Shannon-Kotelnikov. Modulation. Analytic signals.		
XP01NLA	Numerical Linear Algebra	ZK	4
	Background matrix algebra. Norms of vectors and matrices. Numerical linear algebra. Special systems. Eigenvalues and eigenvectors. Iterative methods. Matrix inversion. Singular value decomposition. Generalized solutions of linear systems.		
XP01PDR	Partial Differential Equations	ZK	4
	Problems in partial differential equations of mathematical physics. Initial and boundary value problems. The method of characteristic functions, integral form and numerical methods.		
XP01POA	Advanced theory of operator algebras	ZK	4
	Some advanced aspects of the theory of operator algebras are treated. In particular, structure of ideals, convex structure of the state space, tensor products, cross products, and modular theory.		
XP01SPJ	Syntax and semantics of a formal language	ZK	4
	Syntax and semantics of a formal language.A simple imperative language, assignment command. Denotational and operational semantics, coherence theorem. Mathematical domain theory. Fixed points of functionals, recursive definitions. Lambda - notation. A simple functionl language, denotational semantics. New functions definitions, recursive constructions. Operational semantics. Other approaches to semantics, continuation semantics. Axiomatic (Hoare's) semantics. Expressive power of a programming language.		
XP01TEM	Selected chapters of the measure theory	ZK	4
	Basic properties of finetely additive and sigma-additive measures, classic results (the Radon-Nikodym theorem and the Carathéodory theorem), the extension of finately additive measures (the Horn-Tarski technique, the Banach limit method, some questions of the lifting, etc.), the Hammer-Sobczyk theorem.		
XP01TGR	Graph Theory	ZK	4
	Basic course in graph theory. Trees, their characterization, minimal spanning tree. Strongly connected components, rooted trees. Shortest paths, Floyds algorithm. Euler graphs and their applications, Hamiltonian graphs and their applications. Chvatal's theorem. Flow in networsk, admissible flows and admissible circulations. Matchings in general graphs and in bipartite graphs. Vertex cover and independent sets. Cliques. Colorings. Plannar graphs. Graphs and vector spaces. The content of the course is modified according to the needs of students.		
XP01TJA	Languages, Automata and Grammars	ZK	4
	Finite automata. Nerod theorem and its applications. Nondeterministic automata. Regular expressions nad Kleene theorem. Grammars and their classification. Cotnext-free grammars. Chomsky hierarchy. CYK algorithm for context-free grammars. Turing machines, decision problem. Algorithmically nonsolvable problems.		
XP01UAG	Introduction to Algebraic Geometry	ZK	4
	Affine varieties as the solution sets of systems of polynomial equations in more than one variable and their relationship with the ideals in polynomial rings, Dickson's lemma, Hilbert's basis theorem, Groebner's bases and their properties, Buchberger's algorithm for searching a Groebner's basis, elimination theory, Hilbert's Nullstellensatz, correspondence between varieties and radicals.		
XP01UKS	Introduction to Quantum Structures	ZK	4
	Basic course of quantum structures. The notions of an orthomodular lattice, orthomodular poset, orthoalgebra, effect algebra, state, center are introduced. Basic properties of quantum structures are studied included representations of quantum structures.		
XP01UNA	An introduction to nonassociative algebras	ZK	4
	The basic course in the theory of nonassociative algebra. We introduce the otions of free nonassociative algebra, tensor algebra, bimodules and irepresentations for algebras in a variety. We pay a big attention on the ariety of alternative algebras and composition algebras. We define Lie, alcev and Jordan algebras, their universal enveloping algebras.		
XP01USA	An introduction to superalgebras.	ZK	4
	The basic course in the theory of superalgebras. We introduce notions of a graded algebra, superalgebra, Grassmann envelope of a superalgebra. Consider varieties of superalgebras and identities in superalgebras. We pay a big attention on the variety of alternative and Jordan superalgebras.		
XP01VPS	Selected topics in probability and mathematical statistics	ZK	4
	Students will learn the terms of probability and procedures of mathematical statistics that go beyond commonly taught methods.		

XP01ZOA	Fundamentals of the theory of operator algebras	ZK	4
Basic course of the theory of operator algebras aimed at the theory of C* algebras and von Neumann algebras in its concrete Hilbert space representation. The state space, GNS construction and representations are studied. Comparison theory of projections, states and representations is explained. Von Neumann algebras are classified as finite and infinite and structural types I, II, III.			
XP01ZWT	Wavetet Transform.	ZK	4
Hilbert spaces. Continuous wavelet transform. Time and frequency localization. Discrete wavelet transform. Riesz bases and frames. Multiresolution analysis. Applications to signal processing.			
XP02AMA	Active Methods in Acoustics	ZK	4
Physical principles, interference, Huygens principle, sound field in ducts, vawe-guides and enclosures. Active noise control in a duct. One or more secondary sources. Active control in enclosures, acoustic coupling, modes, local control. Feedback and feedforward strategy, analog adn digital realisations, algorithms based on LMS, stability of algorithms, multichannel algorithms. Practical realisations of active systems. Active control of vibrations, transducers for active control.			
XP02AME	Active Methods in Acoustics	ZK	
XP02BFY	Biophysics	Z,ZK	4
Physical processes related to blood flow, measurement of haemodynamic parameters in vivo, properties of blood vessels. Special attention will be given to artificial capillary systems and their application in treatment of renal or lung insuficiency. The students will learn how to measure blood pressure under various degrees of load and they will observe their own ventilation parameters. Theoretical knowledge will be complemented by practical experience from excursions.			
XP02DP	Electric Discharges and their Applications	ZK	4
Classification of electric discharges. Townsend?s theory. Glow discharge. Processes on the surface of electrodes. Technological applications. Plasma displays. High-frequency and microwave discharge. Arc. Corona. Spark discharge. Lightning. Ball lightning. Z-pinch and its properties. Electromagnetic collapse. X-ray sources, controlled fusion. Generation of magnetic fields of Earth.			
XP02EVA	Physics for Electroenergetics	ZK	4
Lessons contain selected parts of physics for students of electric power engineering: Physical principles of gas discharges - glow, arc, spark and corona discharges and their applications. The students become acquainted with characteristics for magnetized, astrophysical and fusion energy generation. A part of the course is two excursions in laboratories CTU and Czech Academy of Sciences.			
XP02FPL	Solid State Physics	ZK	4
The course provides fundamentals of solid state physics at large.			
XP02FPT	Physics for Therapy	Z,ZK	3
Lectures will be focused to Over Using Syndrome problems. Besides that, there will be discussed pain treatment for patients with cancer. A significant room will be dedicated to electrotherapy, physiotherapy and phototherapy. Also healing processes, organ conservation methods and progressive surgery methods will be spoken about. Students will also gain many practical knowledge via labs.			
XP02HS	Noise Surveys	ZK	4
Sound field, noise and vibration measurement, noise legislation, hygiene control. Types of noise surveys, examples, types of noise sources. Noise mapping, principles and types of sources. Noise in working environment. Noise in buildings. Transport noise, airport noise. Technical principles of noise control.			
XP02MHD	Magnetohydrodynamics	ZK	4
Qualitative description of the behaviour of hot plasma in magnetic fields			
XP02MPF		Z,ZK	2
XP02PT	Plasma Technologies	ZK	4
XP02SF	Statistical Physics	Z,ZK	4
The lecture is devoted to the fundamentals of statistical physics. It is the third part of four-part lecture cycle.			
XP02TF1	Theoretical Physics 1	Z,ZK	4
The lecture Theoretical Physics 1 is a basis for the following lectures of theoretical physics for the doctoral study. The main aim is theoretical Mechanics - to master the description of motion in curvilinear coordinates.			
XP02TF2	Theoretical Physics 2	Z,ZK	4
The lecture is devoted to the fundamentals of quantum physics in Dirac formalism. It is the second part of four-part lecture cycle.			
XP02TZP	Theory of Sound Field	ZK	4
The aim of this course is deeper understanding the fundamentals of physical acoustics. The continuity equation, Euler and Navier-Stokes equations and the energy equation are derived from the prime laws of fluid dynamics. These equations are utilized for derivation of a linear wave equation under the acoustical approximation; its special solutions are discussed. General solutions of the wave equation and Helmholtz equation are formulated using the integrals of Kirchhoff-Helmholtz and Rayleigh. Using these integrals, some problems of acoustic radiation and diffraction are studied. Problem of the acoustic field description is further developed using the methods of Fourier acoustics.			
XP02UEF	Introduction to Electrophysiology	Z,ZK	4
Course is oriented on anatomical, physiological and physical aspects of selected electrophysiology problems.			
XP02UFL	Introduction to Laser Physics	ZK	4
The subject introduces the basics of laser physics. It explains the principle of laser operation, presents basic terms and describes in detail individual types of lasers, including their construction, characterizes the main properties of laser radiation and briefly indicates the possibilities of creating short pulses of radiation. The next part focuses on the use of lasers in various areas of human activity. It also lists safety principles for working with lasers. In the practical part, it is supplemented by visits to top workplaces (e.g. PALS, ELI, HiLASE) dealing with the given issue.			
XP02UZ	Ultrasound and Quantum Acoustics	ZK	4
The purpose of these lectures is to familiarize doctoral students with the issues of ultrasonic waves needed for the design of a wide range of ultrasonic devices and to discuss in detail the parts that the doctoral student could use in his work. The subject of the offer is a range of classic and recently developed findings from research.			
XP02VNP	Plasma Waves and Instabilities	Z,ZK	4
Basic wave phenomena will be introduced in the first part of the lecture (dispersion relation, phase and group velocities, Fourier analysis). Fundamental plasma dispersion relations will be derived from the linearized MHD equations (magnetoacoustic waves - Alfven, F and S wave; electromagnetic waves in plasma - O, X, R, L wave, CMA diagram). The second part of the lecture will be devoted to final size waves, nonlinear phenomena (Landau damping) and solitons in plasma.			
XP02VPA1	Selected Topics of Physics 1	ZK	4
XP02VPA2	Selected Topics of Physics B	ZK	4
XP02VPB	Selected Topics of Physics B	Z,ZK	4
XP02VPO	Selected Topics of Optics	Z,ZK	4
Properties of light, wave equation, plane wave, polarization, reflection and refraction, natural and artificial anisotropy, optical modulators, coherence, interference, thin films, interferometers, diffraction, optical grating, holography, methods of visualization, normal and anomalous dispersion, optical image formation, optical devices, photometry, colorimetry, atoms radiation, stimulated emission, lasers.			

XP02ZFP	Fundamentals of the Plasma Physics	ZK	4
This course will provide you with a basic knowledge of plasma physics and of its applications. Plasma definition. Main plasma characteristics. Collisions of charged particles. Fluid model.. Magneto-hydrodynamics. Aplications.			
XP04A1	English language 1	NIC	
The course revises general English from previous studies, further develops speaking skills, listening and recalling spoken English as well as note-taking skills. Provides basic scientific terminology (cause-effect relationship, definitions, classification, basic information on composing written documents).			
XP04A1ZK	English language 1	ZK	0
The subject A1 ZK is only for those postgraduate students studying in older study program valid up to Sept.2003 and did not ask for studying languages according to the newer study program .			
XP04A2	English language 2	NIC	
The art of composing written documents (papers, reports, articles, dissertations, official letters); oral presentations, reading skills (getting both general and detailed information); the art of understanding speech in a foreign language ; selected parts of difficult grammar; selected items focused on practical skills (reading mathematical symbols and expressions, writing CV). Oral presentations.			
XP04A2SZK	English Language	ZK	0
XP04A2ZK	English language 2	ZK	0
Subject is only for those postgraduate students who study in older program valid up to Sept.2003 and did not ask for studying the new language program.			
XP04AZK	English Language	ZK	0
http://www.fel.cvut.cz/anketa/aktualni/courses/XP04AZK			
XP04C1ZK	Czech language 1	ZK	0
XP04C2ZK	Czech language 2	ZK	0
XP04F1	French language 1	NIC	
Basic knowledge of grammar and vocabulary, with the emphasis on technical style ; ability to understand technical texts on an intermediate level (tested on reading cca 60 pages of texts). Oral presentations - ability to talk on subjects studied by the postgraduate student. Writing cover letters , CV, answering advertisements etc.			
XP04F1ZK	French language 1	ZK	0
XP04F2	French language 2	NIC	
Very good proficiency both in grammar and lexical issues with emphasis on what is typical for technical style. Ability to be oriented in a more difficult text, reading comprehension of texts (cca 120 pages). Oral presentations, i.e. ability to talk about problems on a sufficiently good level, (both language and content level studied by postgraduates). Mastering language skills related to job applications, cover letters etc.			
XP04F2ZK	French language 2	ZK	0
XP04MIN	English Language 2	ZK	0
English exam in form of defense of professional study in English. The task of the doctoral student before the committee to defend his professional work drafted and presented in English. As part of the subsequent discussion. PhD student is evaluated in presentation skills , mastery of the language in continuous speech and language skills quickly and correctly respond during the debate . Account is also the linguistic correctness of written text.			
XP04N1	German language 1	NIC	
Extending skills with the emphasis on professional language. Listening to authentic technical texts from areas of electrical engineering , eliciting basic information from the text. Reading and analysis of professional texts regarding the needs of postgraduate students. Training of various reading skills. Writing technical texts on specific topics, CV, job applications, conversation lessons for advanced students based on 5 video tapes about these topics: postgraduate studies, professions, internships abroad, professional and scientific work, the profession of an engineer. Revising and extending typical grammar for technical style, syntax of technical texts.			
XP04N1ZK	German language 1	ZK	0
Extending skills with the emphasis on professional language. Listening to authentic technical texts from areas of electrical engineering , eliciting basic information from the text. Reading and analysis of professional texts regarding the needs of postgraduate students. Training of various reading skills. Writing technical texts on specific topics, CV, job applications, conversation lessons for advanced students based on 5 video tapes about these topics: postgraduate studies, professions, internships abroad, professional and scientific work, the profession of an engineer. Revising and extending typical grammar for technical style, syntax of technical texts.			
XP04N2	German language 2	NIC	
The course is focused on extending and elaborating grammar and conversation, namely on professional language skills (reading + writing technical texts, preparing papers, reviews, presentations etc.)ations etc.)			
XP04N2ZK	German language 2	ZK	0
XP04R1	Russian language 1	NIC	
The course is suitable for intermediate students who have an equivalent command of the language as someone who has completed book Raduga. Course objective: Acquiring the language skills required to get by in everyday situations and a basic understanding of straightforward technical texts.			
XP04R1ZK	Russian language 1	ZK	0
XP04R2	Russian Language 2	NIC	
Writing technical texts including messages, summaries, business correspondence and dissertation theses; understanding lectures and other listening skills; note-taking; oral presentations; structures and pronunciation. Russian realia and the way of Russian life.Besides the course books, the supplementary texts and AV aids are used.			
XP04R2ZK	Russian language 2	ZK	0
XP04S1	Spanish language 1	NIC	0
Increasing active knowledge of Spanish language, including the language for specific purposes.Specific technical style characteristics focused on specific grammar and lexis.Listening comprehension, oral presentations, understanding the text-all based on intermediate level language.			
XP04S1ZK	Spanish language 1	ZK	0
XP04S2	Spanish language 2	NIC	0
Basic language skills(listening,understanding a Spanish text of cca 120 pages, writing, speaking). The skills are practiced on writing letters, presentations both written and oral,news etc. Individual home preparation is necessary. Materials are chosen with regards to the study field of a postgraduate. High-level and fluent speech is demanded.			
XP04S2ZK	Spanish language 2	ZK	0
XP04Č1	Czech language 1	NIC	0
XP04Č2	Czech language 2	NIC	0
XP12IMM	Engineering Methods in Mechanics	Z,ZK	4
Review methods solution of problems in rigid bodies mechanics, hydromechanical , thermodynamic and electromechanical systems. Dynamics of combined systems with using methods of vectorial and analytical mechanics, assembling of mathematical model and resources for simulation. Identification of system parameters with respect to passive resistances and energy losses. Physical similarity and analogy, dimensional analysis, dimensionless parameters, PI-terms,fundamentals of experimental research			

XP12VVM	Development and Research of Materials	Z,ZK	5
Research of composite materials wth specific electrical properties. Diagnostics of materials in electrotechnology. Polymers. Phase transitions. Thin and thick conductive layers on polymers. Organic solar cells. Models of function of biomaterials.			
XP13DEZ	Degradation processes of electridal equipment	Z,ZK	4
The course familiarizes students with the basic processes of degradation, which is exposed to the electrical product in a production environment. The student will apply this knowledge to a specific product for a model operating environment. The student should try to verify the dominant degradation process of the product in the laboratory or perform its computer simulation. Attention is also paid to environmental aspects associated with the choice of materials (technology) that are able to limit the degradation process.			
XP13DFD	Data and Functional Analysis of Production Systems	Z,ZK	4
Technological system of production enterprise and its structure. Relationship of technological system to other systems. Tools of control and information of enterprise, distributed systems. Methodology of analysis of enterprise. Date base of technical preparation of production. Methodology of functional analysis of enterprise. Methods of data and material flows analysis. Methods of analysis of user interface of enterprise IS. Object oriented methodology of analysis of enterprise. Methods of time analysis of enterprise. Use of Petri nets for analysis of enterprise. Documentation and standards for data and functional analysis. Automation of analysis methods, CASE tools.			
XP13DTF	Thin film diagnostics	Z,ZK	4
Surface characterization. Definition of a thin film. Deposition methods; chemical vapor deposition, physical vapor deposition. Thin film characterization: optical methods; electron diffraction. Ion implantation. X-ray diffraction and photoelectron spectroscopy. Thickness, mechanical, optical and electrical properties.			
XP13FCD	Photovoltaics systems	Z,ZK	4
The course discusses the most important problems of principle, technology of production and final use of photovoltaic systems for power generation. Topics: Solar energy and basic principles of conversion. Photovoltaic effect, photovoltaic cells. Optimization of cell structure in terms of optical and electrical properties of individual layers. V-A characteristics of photovoltaic cells. Determination of the maximum theoretically achievable energy conversion efficiency of a given structure. Photovoltaic modules. Technological processes of production of basic types of photovoltaic cells and modules. Characterization and diagnostic methods, analysis of failure types, influence on durability. Photovoltaic systems (autonomous, connected to the grid). Components of photovoltaic systems. Simulation of yield for a given type of climate and season. Trends in applications of photovoltaic systems and economic aspects.			
XP13FDD	Physic of Dielectrics	Z,ZK	4
Types and mechanizmus of polarization. Dielectric absorption. Electrical conductivity of insulators. Dielectrics in static electrical field. Dielectrics in time-dependent electrical field. Frequency dispersion of polymers. Thermal dispersion of polymers. Optical properties of dielectrics. Dielectrics losses. Electrical strength of insulators. Electrical properties of thin dielectrics films. Ageing of insulators. Properties of feroelectrics. Main and joined phenomena in dielectrics.			
XP13FPD	Semiconductor Physics	Z,ZK	4
The aim of the course is to deepen the knowledge of the properties of semiconductor materials and structures that are important for a deeper understanding of the semiconductor components technology .			
XP13MSD	Modelling and Simulation of Technological Systems	Z,ZK	4
Program tools of computer modelling and simulation. Programs processing port diagrams or block diagrams. Text edited systems and examples. Graphic edited systems and examples - SIMULINK. Modelling of electric and electronic systems. Models of power semiconductor devices, modelling of power semiconductor systems. Examples of simulations. Modelling of mechanical and electromechanical systems, hydraulic systems and thermal systems. Examples of simulations.			
XP13NM	New Matherials and their Application	Z,ZK	4
The course is focused on the topic of the doctoral thesis, e.g. carbon materials and composites, conducting polymers and composites, biomimetic materiály, selfassembly, glassy materials, and new materials for actuators.			
XP13PED	Plastics in Electrical Engineering	Z,ZK	4
Exploitation plastics in electrical manufacturing. Exercise plastics in the production of the cables, structural members etc. The specialty requirements on the plastic materials (conductance, the mechanic rigidity, of shape constancy). Composite materials from out plastics. Technology treatment of plastics. Degradation of plastics impact of environment(climatic and the mechanic stability and chemical resistance). The plastic waste. Recycling of plastics. Impact of production and the used up plastics on the environment.			
XP13PSD	Flexible Production Systems	Z,ZK	4
Evulutionary stages of automation. Flexible automation. Basic components of FMS. Machining centres, flexible manufacturing cells and islands. Option, allocation and control of tools. Control of FMS and its components. Interfaces. Systems of automatical self checking of quality. CNC machines appropriate for FMS. Manipulators and robots as the components of FMS. Transport and its control. CNC for the control of FMS. Flexible assembling systems. Automated plants of future, conception and tasks. Efficiency of FMS. Personal problems.			
XP13SAV	Statistic analysis and technological data evaluation	Z,ZK	4
XP13SID	Software in Industrial Engineering	Z,ZK	4
Introduction to using of IBM compatible personal computers, their architecture. Using of application programs for mathematics, graphics, text processing, database and CAD, examples of software systems. Introduction to user interface based on Microsoft Windows.			
XP13SJD	Quality Control Systems	Z,ZK	4
The concept of quality and reliability. Basic quality management systems. ISO 9000, TQM, Kaizen. Basic characteristics of ISO 9000. Quality manual. Quality loop. Factor experiments and their role in quality. Mathematical model based on factor experiments. Optimization of mathematical model. Six Sigma quality management system and its implementation. Basic tools of the Six Sigma system. Reliability as a subset of quality. Mathematical distributions used in the field of reliability. Usage and maintenance coefficient. Backup - types and mathematical description. Accelerated reliability testing. Processing and analysis of experimental data.			
XP13SRD	Real Time Systems for Process Control	Z,ZK	4
Introduction to using of real time control paradigm. Architecture of real time systems. State transition diagram of real time systems. Semaphore and deadlock. Using of real time systems in control of technological systems.			
XP13SSD	Special Methods of Devices Quality Evaluation	Z,ZK	4
The evaluation of the principal values determining the quality of the passive and active devices. Measuring methods, their evaluation , identification of systematic faults. The description of the tested device, two ports parameters of the device. Matching of the device to the measuring circuit. The noise of the electronic circuits, optimal noise and power matching. Non-linearity of the "linear" circuits, intermodulation distortion, measuring of the non-linearity and intermodulations.			
XP13TMD	Technological Aspects of Microcomputer Design	Z,ZK	4
Industrial microcomputers, modular design and hardware solution. The data storage technology. The data storage media. The device protection against environmental influence. The cooling and air condition of equipments. The human machine interface - input and output devices. The ergonomic design of microcomputers and special devices. The quality of microcomputer systems, criteria. The quality control of design and services, the quality of software. The legal aspects of microcomputer use. The contemporary trends in industrial microcomputers.			
XP13TND	Technology of Low Temperatures and Superconductivity	Z,ZK	4
Thermodynamic principles of cooling. Equipments for achievement of low temperatures, liquifiing of gases. Ultralow temperatures. Properties of isotopes of He and selected gases. Physical properties of solids at low temperatures. Principles of superconductivity theory, transport currents, stability of superconductivity state, weak superconductivity, tunneling phenomena. Properties and technology of metallic and high temperature superconductors. Thermal insulation of low temperature equipments. Low temperature thermometry. Accessories and work in low temperature laboratory. The use of low temperature technology in practice.			
XP13TPD	Technological Processes in Electronic Manufacturing	Z,ZK	4
Development of technology of packaging. Contemporary methods of packaging of components SOP, DIP, SIP, ZIP, QFP and others, properties, advantages,disadvantages. Comparison of packages from the viewpoint of environmental resistivity. Classification of multichip modules. Multichip modules of different types: MCM-L, MCM-C, MCM-D, PMCM. Substrates for			

	multichip modules. Technology of contacting og dies. Electrical design of MCMs. Thermal design of MCMs. Physical design of MCMs. Parameters for evaluation of MCMs. Reliability of MCMs. Design tools. Programmable modules. Applications of MCMs.		
XP13VNM	Research of new materials	Z,ZK	4
	The course will cover the topics of materials such as Piezoelectrics, pyroelectrics and ferroelectrics without lead, Multiferroics, Special magnetic elements, Carbon materials and carbon nanomaterials, Bio-inspired materials and hybrid organic inorganic materials, Polymers and composites containing polymer for electrical engineering, Nanofibers, Metals (ODS, HEA alloys) with controlled content of amorphous / crystalline / nanocrystalline mass, Metals with extreme dependence of electrical resistance on temperature, mechanical load and its influence on material behavior, Carbides and nitrides (MAX phase). Critical methods for study of these materials will be discussed - Characterization of materials by diffraction and spectroscopic techniques, Characterization of materials by microscopy (SEM, TEM, polarized light, confocal), Characterization of materials by impedance analyzers, Modeling and simulation of temperature and el. fields.		
XP13VTK	Vacuum technology and cryogenics	Z,ZK	4
	Physics of gas. Voluminous processes. Surface processes. Processes circulative to wall. Vacuum pumps. Measurements in vacuum techniques. Principles of cooling and constructions of real equipments for achievement of low temperatures. Properties and behavior of matters at low temperatures. Transport of heat and insulating systems used in cryogenics.Low temperature thermometry.Laboratory training and seminars are focused to obtain a basic practical proficiencies and the other knowledges in vacuum technology and cryogenics.		
XP13VVM	Development and Research of Materials	Z,ZK	4
	Research of composite materials wth specific electrical properties. Diagnostics of materials in electrotechnology. Polymers. Phase transitions. Thin and thick conductive layers on polymers. Organic solar cells. Models of function of biomaterials.		
XP14APD	New Trends in Electric Device Applications	ZK	4
	New trends in development and design of electric apparatus. Electric apparatus and electric devices co-operation. Electric apparatus switching characteristics and their influence on switched circuit. Switching overvoltage and possibility of its limitation. Up to date systems for overvoltage limitation. Problems of high voltage motor switching. Electric apparatus measuring and testing up to date methods. Internal smart installations. New generation of building installations.		
XP14APR	New Trends in Electric Device Apply	ZK	3
XP14DES	Dynamics of Electric Machines	ZK	4
	Electric machines play an important role in a number of areas, such as e-mobility, renewable energy sources utilization, robotics and automation. The main objective of the course is to provide the students with deep understanding of the principles, operation, and analysis of rotating electric machinery. Mathematical models based on the theory of space phasors or FEM will be developed for various types of electric machines (induction machines, electrically excited synchronous machines, permanent magnet synchronous machines). Thorough understanding of electrical machine theory on such a level is necessary, for instance, for design of modern control methods of electric drives or construction of electric machines.		
XP14DSD	Dynamics of Electric Machines	ZK	4
	Assumptions for electric machine general theory. Mathematical transformation systems, per unit system. Mathematical model of DC machine, of synchronous and induction machine, of collector machine. Electro-dynamic transient phenomena in electric machines. Short-circuit. Switching of the motor on the network. Electromagnetic torque and its components. Synchronous motor oscillation. Circle diagram methods for transient effect solves. Non-symmetrical short-circuits.		
XP14ECD	Electromagnetic Compatibility	ZK	4
	Interference sources. Different manner and coupling factors of interference spreading. Grounding influences. Screening. Non-linear electric appliances influence on power quality. Current and voltage forms of different electric appliances. Harmonic current and voltage components of different electric appliances. Steady state and transient current and voltage harmonics components. Interference suppression of converters on the network. Compensation and filtration substations.		
XP14EMC	Electromagnetic Compatibility	ZK	4
	Interference sources. Interference coupling. Shielding. Earthing. Nonlinear consumers. Harmonics in electric convertors in steady and transient conditions. Supression of negative converor influences on the network. Compensation and filtration.		
XP14MEN	New Trends in Converter Technology	ZK	4
	The aim of the study is to introduce students to the principles and functions of latest topologies of power semiconductor electric energy converters, taking into account the scope of their PhD thesis. Content of the subject is the optimization of the power conversion parameters in power semiconductor converter systems. The subject is oriented mainly on new trends in the use of new principles, topologies, functions and possibilities of application of power semiconductor converters realized on the basis of modern power semiconductor devices and using increasingly powerful control microcomputers. The topics are focused on pulse width modulation methods for voltage and current control, modes of operation of converters with unity power factor, active control of the current curve and the voltage curve, as well as the overall quality of electric energy transmission. The problems of analysis and synthesis of matrix converters, multi-level converters, resonant converters as well as problems related to their practical use are also solved.		
XP14MID	Microprocessor Control of Electric Drives	ZK	4
	Control computers, their architecture. ADC, DAC special circuits, DMA, measurement of pulse parameters. Event memories, FIFOs, CAMs, multiport RAMs, gate arrays. Serial communication. DSP processor concept, fast computing, interface issues. Parallel information processing. Multiprocessor systems. Real-time system, SW, HW design techniques. Polled loops, phase/state driven systems, F/B systems. Interrupt driven system, full featured kernels. Tasks, intertask communication, queues, semaphores. Control algorithms design and issues. SW, HW design examples.		
XP14MIP	Microprocessor Control of Electric Drives	ZK	4
	The aim of the course is to introduce students to the latest issues of mikroprocessor application in control and regulation of electric drives. The course deals with topics of control computer, digital signal processor (DSP) architecture, computational resources, fixed point, fraction, floating point arithmetic, interrupt system, DMA controller, special blocks, ADC, event memory, FIFO, CAM, Multiport RAM, impulse signal generation, serial communication, methods, buses, protocols, synchronization, multiprocessor systems, parallel processing, RT systems, preemptive RTOS, tasks, queues, semaphors, critical section, control computer programming methods, control computer resources application in scalar and vector control of electric drives.		
XP14MIR	Microprocessor Control of Electric Drives	ZK	3
	Control computer, digital signal processor (DSP), digital signal microcontroller (DSC), architecture, computational resources, fixed point, fraction, floating point arithmetic, interrupt system, DMA controller, special blocks, ADC, event memory, FIFO, CAM, Multiport RAM, impulse signal generation, serial communication, methods, buses, protocols, synchronization, multiprocessor systems, parallel processing, RT systems, solution methods, systems: INT, BG-FG, FSA, CC, preemptive RTOS, tasks, queues, semaphors, critical section, control computer programming methods, control computer resources application in scalar and vector control of electric drives.		
XP14MPD	Advanced Control Methods of Electric Drives	ZK	4
	Development trends in electric drive control. Application of microprocessor technology, program realization of algorithms for modern drives, modulators, realization of direct and indirect induction machine torque control, converter with harmonic current control for synchronous machine, functions and control of compatible rectifier, preview of modern controllers for electric drives.		
XP14MPO	Advanced Controlled Drives	ZK	4
XP14MRP	Advanced Controlled Drives	ZK	3
XP14MTD	New Trends in Converter Technology	ZK	4
	Up to date power semi-conductor devices. Pulse Width Modulation methods for current and voltage control. Single-phase PWM converter. Converters with unity power factor. Single-phase converter with active current shape control. Three-phase converter with active current shape control. Converter with active voltage shape control. Converters for multisystem locomotives. Resonant converters.		

XP14MZR	New Control Methods for Electric Drives	ZK	4
The aim of the course is to introduce students to the latest issues of control and regulation of electric drives, taking into account the focus of their doctoral work. Its purpose is to optimize electromechanical energy conversion parameters in electric drive systems and relevant power electronics, in particular by using modern control and regulation algorithms. The course is mainly focused on electric AC drives, especially drives with asynchronous and synchronous motors.			
XP14NAP	New Trends in Electric Device Apply	ZK	4
XP14NTP	New Trends in Electric Device Theory	ZK	4
XP14RPD	Advanced Controlled Drives	ZK	3
AC motor with variable frequency feeding. Current source converter. Voltage source converter, PWM, Electromagnetic torque by feeding from frequency converters. Vector oriented control system, Direct and indirect torque control system, Self-controlled synchronous motor drive. Methods for rotor position determination. Switch Reluctance Motor, SD motor.			
XP14TPD	New Trends in Electric Device Theory	ZK	4
Switching arc latter models and theory. Switching arc physics. Interaction between switching breaker and electric circuit. New knowledge in electric arc extinguishment. Influence of extinguishing medium on physical process in arcing chamber. Switcher braking capacity and possibility of their inducement. Fuses theory. Electric circuit braking with short current limitation. Electric contact theory.			
XP14TPR	New Trends in Electric Device Theory	ZK	3
XP15DVN	Diagnostics of HV and EHV Insulating Systems	Z,ZK	4
Failure rate of operation, fault sources and mechanisms. Indoor and outdoor insulation of electrical equipment. Diagnostic methods, using in operation. Choice of methods for diagnostic systems. Application of database systems for electrical machines and equipment of HV and EHV. Application of systems with element of artificial intelligence in electro diagnostics.			
XP15EH	Energy Economy	Z,ZK	4
Energy economy, part of national economy.Terminology of energy economy.The energy systems. Forecast of energy consumption.Energy balance in production field, Energy balance in buildings. Energy economy and its impact to environment. Energy economy on the organization level.The control of energy economy. Basic problems of energy policy.			
XP15ES	Electrical Lighting	Z,ZK	4
Visual sensory processes. Light micro climate design. Daylight, artificial and mixed lighting. Visual performance. Visual comfort. Colorimetry. Light sources. Luminaire characteristics. Lighting systems. Exterior and interior lighting. Lumen method. Integrated and remote controlled lighting systems.			
XP15ET	Electroheat	Z,ZK	4
The definition of fundamental equations of heat and mass transfer in electromagnetic field in continuum. Thermal effects of electromagnetic field. The definition of the problems of induction, dielectric and arc heating. Similarity and analogy of equations and their use. Numerical methods in electroheat.			
XP15EXE	Expert Systems in Electrical Power Engineering	Z,ZK	4
Data processing and evaluation. Expert systems in electrical power engineering and diagnostics of insulating systems. Application of rule-based expert systems and neural networks in electrical power engineering and diagnostics of insulating systems. Creation of expert systems for electrical power engineering and electro diagnostics.			
XP15EZP	Control in Power Engineering	Z,ZK	4
Overview of enviromental problems. The role of power engineering. Global climate change. The greenhouse effect. Carbon dioxide emissions.Impact of nuclear power plants.Impact of hydro power plants. Renewable energy sources.Methods and technology for decreasing of impact to environment. Electric power transmission and the environment. The control of power energy system			
XP15FAK	Photometry and Colorimetry	Z,ZK	4
Principle of photometric methods. Standards of luminance and luminous flux. Receivers of radiation and modification of their characteristics. Photometric distance. Measurement of light source parameters. Luminaire parameters. Measuring of indoor lighting systems. Measuring of outdoor luminance and illuminance. Colour vision theory. Chromaticity. Colour. Colorimeter space. Colour rendering-index. Chromaticity system.Diagram of chromatic. Colorimeter. Spectroscop			
XP15MPE	Mechatronics in Electrical Power Engineering	Z,ZK	4
Basic model modules, models and control systems of steam generators,steam and water turbines and nuclear reactor. Dynamics and control of STATCOM and power factor compensatores.			
XP15MVN	High Voltage Measurement	Z,ZK	4
Types of testing voltages and high voltage generators. Measurement cables, attenuators. Disturbances of HV measurement. Measurement of impulse voltages by voltage dividers, types of dividers. Dividers for measurement of fast transients, calibration of dividers. Measurement of DC high voltages, HV resistors and dividers. Measurement of AC high voltages, instruments for measurement of RMS voltages. Instruments for measurement of voltage peak values. Measurement of high current, shunt reactors, Rogowski coil. Measurement of current on potential by utilization of optical-fibre waveguides. Voltage tests of transformers. HV measurement of dielectrics.			
XP15PEE	Transmission of Electricity	Z,ZK	4
Types of networks and transmission systems. Multiple overhead lines. Symmetrical components. Calculation of load flow. Analysis of faulted power systems, different types of shunt and series faults and simultaneous faults. Special transients in the integrated power systems. Distance and comparison protection relays, principles and applications. EMC and interferences in power networks, prediction and limitation of disturbances due to non-linear loads. Static stability of the power system and its criteria. Dynamic stability of the power system and its criteria. Methods for increasing of the stability in power systems. Multimachine transient stability. Reliability of the power transmission systems.			
XP15RE	Control of Power Systems	Z,ZK	4
Objective functions of power system control, feasibility and algorithms of optimization methods, handling of constrain conditions. Hierarchy and decomposition of system controlling tasks. System state estimation. Load forecasting and load curve civering. Unit commitment. Optimization of operation with respect to net topology constrains.Control of voltage and reactive powers balance. Control of frequency and active powers balance. Optimal power flow. Dynamical models of power stations and systems.Solution of extraordinary states.. Dispatch, system and subsidiary services.			
XP15SPS	Coupled Problems in Heavy Current and Power Engineering	Z,ZK	4
Concept of a coupled problem, classification of the coupled problems typical for heavy cur-rent and power applications. Mathematical description of the relevant physical fields, links between corresponding partial differential equations. Characteristics of electromagnetic-thermal problems (with respecting eventual thermoelasticity), electromagnetic-thermal-hydrodynamic and electromagnetic-mechanical problems and also problems based on a com-bination of the electromagnetic field and electric circuits. Formulation of their mathematical and computer models and algorithms of their solution. Information about available SW, its existing capabilities and perspectives.			
XP15TOS	Theory of Light field	Z,ZK	4
Theory of light field. Mathematical description of emission of unsymmetrical luminaires. Photometry of distante and close point. New characteristics of space properties of illumination. Flux method calculation of integral characteristics. Light field of surface type and cube type luminaire. Light flux distribution from point source. Distribution of light flux of linear source. Distribution of light flux of surface source. Interreflection theory. Design of indoor illumination using PC.			
XP15UEE	Electric Energy Use and Conservation	Z,ZK	4
XP15VME	Research Methods in th Use of Electrical Energy	Z,ZK	4
Introduction into the mathematics of continuum physics. Physical conservation laws. The laws of electromagnetic field. Similarity theory in thermo-aerodynamics. Similarity theory in electromagnetic field. Mathematical modeling. Analytical solutions of electromagnetic field. Discrete parameters and their relation with field parameters. Numerical access to deterministic mathematical modeling of fields. Non-deterministic modeling. Experiment and data processing, practical examples.			
XP15ZSS	Light sources and Equipment	Z,ZK	4

XP16AFM	Advanced Financial Management Methods	ZK	4
The aim of the course is a deeper understanding of the more complex financial management issues. It builds on knowledge of standard financial management courses. The main topics are alternative capital market models, other investment valuation methods (generalized NPV method, general IRR method). The student will learn how to protect against risk using derivatives, evaluating exotic derivatives. In addition, students will assess using the Monte Carlo method the value of derivatives and financial instruments for which the so-called closed formulas are not available. Other modern finance issues will be addressed through case studies. An integral part is the question of numerical methods, their reliability and their practical use. Students create their own models and simulations based on the chosen topic. The output will be a comparative analysis of the proposed methods and standard methods. The wide use of computational tools and models (Matlab, Mathematica, others) is assumed.			
XP16DEL	History of technology and economic	ZK	2
XP16ECM1	Quantitative research methods in economy 1	ZK	4
This course is a direct sequel to Statistics/Linear regression. The objective of the course is to expose the student to variety of common and practical econometric challenges with the ultimate goal of gaining a stronger appreciation of strengths and weaknesses of econometric methodology and to overview historical developments in applied econometrics. The course assumes familiarity with the general linear model and knowledge how to deal with basic model and data deficiencies, simultaneous systems, and simple time-series processes. The course will start developing theoretical topics covered in the essential courses on Econometrics. The course will follow with different empirical research projects drawn from the literature. Each project will be introduced by the relevant economic theory-model. Using own and empirical data sets, the students will apply standard econometrics methods to answer basic economic questions. Exercise sessions will provide introduction into advance use of statistical packages (best is TSP or Stata or their derivatives like E-views) and a feedback on possible solutions of problem sets. The course will require intensive work with data and statistical packages.			
XP16ECM2	Quantitative research methods in economy 2	ZK	4
This course should be a sequel to the basic Econometrics (Basic statistical methods and Linear regression model). It assumes familiarity with the general linear model and knowledge how to deal with basic model and data deficiencies, simultaneous systems, and simple time-series processes. Advanced Econometrics is the next course in a sequence (MA course(s) in Statistics and on Regression) designed to introduce tools necessary to understand and implement empirical studies in (micro)economics. The main emphasis of the course is twofold: (i) to extend regression models in the context of cross section and panel data analysis, (ii) to focus on situations where linear regression models are not appropriate and to study alternative methods. The objective of the course is to expose the student to variety of basic applied microeconomic challenges with the ultimate goal of gaining a stronger appreciation of strengths and weaknesses of the econometric methodology. Examples from applied work will be used to illustrate the discussed methods. Selected topics from advanced econometrics will be covered as well.			
XP16EES	Economics of energy systems	ZK	4
The aim of the course is to acquaint students with the emerging issues and problems associated with decentralization and liberalization of energy markets. These are two main groups of issues: how to address economic issues within interconnected markets and how to address economic issues within a decentralized market. In the course, students will learn how to connect technical calculations with the determination of economic variables - especially prices. Key issues are supply zones, transit payments, loss-sharing, re-dispatch. It is also about dividing costs between customers, setting tariffs for electricity, dividing effects from decentralized production and more. Within the subject, the students will replicate the calculations and procedures that are currently delivered within the interconnected electricity system. The aim is to analyze and identify the strengths and weaknesses of these processes.			
XP16EKO	Economics	ZK	4
Basic economic terms. Principles of microeconomics, consumer behaviour and producer behaviour. Profit maximization. Perfectly competitive market. Market failure, monopoly. Principles of macroeconomics, aggregate demand and aggregate supply. Labour market. Money market and capital market. Macroeconomic policy of the government as a factor protecting and correcting the market. Comment: The subject is a necessary precondition for understanding other economic and managerial disciplines.			
XP16EME	Economics and Management of Energetics	ZK	4
Organizational structure of electric power sector, heating and gas sector. Principles of integrated source planning. Revenues, costs, prices and tariffs of energy. Governmental energy policy. Development of international cooperation in power industry and its economic and ecology aspects.			
XP16EPM	Economics of power markets	ZK	4
The subject provides basic theoretical knowledge about the organization and functioning of electricity markets. The starting point is the theory of short- and long-term marginal costs and the generation of the electricity supply curve. This is followed by the theory of integration of electricity markets and the creation of economic welfare (social welfare). Current trends in power generation tend to decarbonise and integrate electricity markets. This, together with the massive rise in electricity from intermittent sources, leads to the need for a new constitution of electricity markets and new business models including demand response and the development of the prosumers concept (where end consumers of electricity are also electricity generators). Part of the subject is also discussion of other links of the electricity market - emission allowances, connection to the heat market and other commodity markets.			
XP16ERE	Economics of power generation from RES	ZK	4
The subject focuses on complex problems of economy of production of electricity and heat from renewable energy sources. The course develops the acquired knowledge in the field of financial management due to the specifics of electricity / heat generation from RES and the expected development of energy markets. Consequently, it deals with the theoretical concepts of the electricity market, taking into account current trends in the decentralization of energy systems, decarbonisation of energy and the expected high penetration of electricity from RES into the electricity market. These trends require the development of different types of energy accumulation and the implementation of smart technologies in the management of network operation. The course also includes modeling of the development of energy systems with high RES share.			
XP16ERU	Accounting	ZK	4
Principles of accounting. International accounting standards (IFRS). Methodology of accounting. Cost, revenues, profit and cash flow. Balance sheet, profit and loss account. Analysis of company's financial position.			
XP16FIM	Financial Management	ZK	4
Principles of finance, present value and alternative cost of capital, net present value, present value of bonds and stocks, investment decision making and net present value, return and alternative cost of capital, risk and return, lease or buy decision, inflation and return, real options, financial options, option valuation, hedging, short term finance, cash flow finance.			
XP16FVT	Philosophical Problems of Science and Technology	ZK	2
The course is engaged in the evolution of principal ideas on which the science and technology are founded. Philosophical aspects of physics and mathematics are deeper examined. Actual themes linked to the so called "Postmodernism" and to the alternative ways of understanding and their social coherences are discussed.			
XP16HDS	History of Transport Systems and Communications	ZK	2
XP16HEL	History of Electrical Engineering	NIC	2
XP16HIS	Historiography of the Development of Science, Technology and the Methodology	ZK	4
XP16HKA	Historical structures and technologies in architecture	NIC	2
XP16HKC	Science, Technics and Technology in the Historic Landscape of the Czech Lands	ZK	4
XP16HPH	History of Physic	ZK	4
XP16JAK	Quality Management	ZK	4
Quality assurance in the organization. Statistical methods in quality management. Models of quality systems. Economic issues in quality assurance. Implementation of requirements of ISO 9001 standard. Certification of products and production systems. Recommendations for quality management in the organization.			
XP16KVM	Quantitative Research Methods in Management	ZK	4
Application of software SPSS for advanced statistical methods as multiple regression and correlation, analysis of variance, factor analysis, cluster analysis and its using in marketing research and management.			

XP16MAN	Management	ZK	4
Principles of management and its innovation, modern ways of management, responsibility of managers, manager's ethics, successful manager thinking and behaviour.			
XP16MAR	Marketing	ZK	4
The role and functions of the marketing management. Marketing research and marketing information system. Concepts of marketing strategy. The use of product life cycle and portfolio. Product and service policy, pricing and contractation policy, communication, distribution. Marketing mix.			
XP16MAS	Marketing Strategies	ZK	4
Broadening of basic knowledge of marketing. The analysis of marketing strategies in different market situations. The firm`s behavior under competition and competitive advantage. Case studies in the field of product policy, price and condition policy, communication policy and distribution policy.			
XP16MAU	Accounting for management	ZK	4
The principles of managerial accounting. Relations to the organisational structure of the enterprise and to the production process. Budgets, use for management. Calculations and cost analyses. Productivity and measurement of productivity in the production process. The managerial information systems.			
XP16MAV	Production Management	ZK	4
The role of production process in promoting the marketing concept of the firm and the competitive advantage. The system of operational planning with respect to production typology. Standardized basis of production management, standardization. Controlling, production management methods.			
XP16MES	Economics and Management of Energy Systems	ZK	4
Strategic questions of electric power sector, gas systems and central heating systems functions. Marginal revenue in electric power system. Marginal costs of electricity, heat and gas. Power elements optimization, subsystem and system optimization in generation and transportation of different kinds of energy. Reliability in energy delivery. International cooperation in power industry. Energy price regulation and its consequences			
XP16MEU	Economics and Management of Energetics	ZK	4
Organizational structure of electric power sector, heating and gas sector. Principles of integrated source planning. Revenues, costs, prices and tariffs of energy. Governmental energy policy. Development of international cooperation in power industry and its economic and ecology aspects.			
XP16MVE	Selected Problems of Economy and Management of Energy	ZK	4
The role of production process in promoting the marketing concept of the firm and the competitive advantage. The system of operational planning with respect to production typology. Standardized basis of production management, standardization. Controlling, production management methods.			
XP16SDE	Building heritage of the industrial era	NIC	2
XP16STM	Selected Statistical Methods	ZK	4
Descriptive statistics.Transformation of random variables.Aproximation of theoretical distributions.Interval estimates.Hypothesis testing.Simple and multiple regression. Analysis of time series.Index number.			
XP16STV	Product Strategy	ZK	4
Product and service policy, pricing and contractation policy, communication, distribution. Marketing mix. Inovations. Concepts of marketing strategy. Reverse marketing. Product management. The strategic marketing simulation Markstrat.			
XP16VPB	Science, Technology and Industrial Boom	ZK	4
XP16VTK	Everyday Science and Technology	ZK	4
XP16VTS	Development of Technical Universities	ZK	4
XP16ZVP	Fundamentals of Scientific Work	ZK	4
XP17ANS	Selected Chapters from Antennas and Propagation	ZK	4
Summary of antennas and modern antenna technology. Selected problems of antennas and propagation for fixed and mobile communication, earth and satellite services. Frequency management for different services and communication. Topics of near a far field antenna measurement, compact antenna measurement. Measurement of signal level for specific services. Antenna anechoic chambers design.			
XP17APL	Applied Optoelectronics in Medicine	ZK	4
Scope and aims of non-invasive measurement techniques in medical diagnostics. Fundamental physiology of the vascular system, hemodynamics, skin anatomy and perfusion. Computer simulation of the cardiovascular system. UV, VIS and IR spectroscopy. Fundamental optics of the eye and color analysis. Optical parameters of biological tissue. Dispersion of light, Design of optical sensors, Optical visualisation principles of translumiscetion and tomography, Optoelectronic systems in medicine.			
XP17ELD	Electrodynamics	ZK	4
XP17LAE	Medical Applications of Electromagnetic Field	ZK	4
Future possibilities of EM Field medical applications. Principals and technical equipment for EM thermotherapy, hyperthermia applicators. Calculation of 3D SAR and temperature distribution. Details of microwave thermotherapy apparatus are given, especially from the point of view of applicators for local, intracavitary and regional treatment. Non-invasive thermometry (NMR, ultrasound and radiometry) and special compatible applicators are described.			
XP17MAPP	Analysis Methods for Passive Elements of Microwave and Millimeter-wave Technique	ZK	4
Computation of transmission lines parameters. Computation of microwave circuits scattering parameters, analysis of planar antennas. Survey of basic methods for analysis of passive circuits with the stress on methods: spectral domain, integration equation, finite differences, finite elements, mode matching, transversal resonance. Survey of basic theorems of electromagnetic fields, moment method, disturbance method.			
XP17MT	Microwave Technique	ZK	4
Microwave transmission lines and its circuit elements including hybrid and monolithic integrated circuits technology. Resonators and other type of passive microwave elements (e.g. attenuators, couplers, isolators and circulators, modulators etc.) and active microwave circuits (e.g. oscillators, mixers and amplifiers), microwave filters, microwave measurement. CAD of microwave circuits.			
XP17MVP	Methodology of Science	ZK	
XP17NME	Numerical Methods in Electromagnetic Field	ZK	4
Poissonous, Helmoholtz and wave equations. Analytical, semianalytical, seminumerical and numerical methods. Matrix equations and algorithms: Mode Matching Technique, Point Matching Method, Method of Moments, Multiple MultiPoles, Boundary Element Method, Finite Difference Method, Finite Element Method, Finite Integration Method. Stability of solution. Solution of matrix equations: direct methods, Gauss-JordanOs elimination, pivotation, LU-decomposition, banded and sparse matrix, conjugate-gradient method.			
XP17OV	Optical Fibers	ZK	4
Waveguiding in optical fibers, attenuation and dispersion, step-index fibers, gradient fibers, single and f1ibers, optical cables, splices and connectors, optical fibers measurements, fabrication, nonlinear phenomena in optical, fibers, fibers for sensors.			
XP17PEM	Advanced Electromagnetism	ZK	3
The course presents advanced topics of classical electromagnetic field theory, especially: electric and magnetic vector potential; reciprocity, duality, and equivalence principle; Green's function; multipole expansion; scattering and characteristic modes; homogenization and Bloch's theorem; synthesis and topological optimization The knowledge gained in this course can be used in many branches of applied electromagnetism, especially in antenna theory and microwave circuit design.			

XP17TAM	Evaluation of Applicators for Microwave Thermotherapy	ZK	4
Lectures are focussed on methodology of evaluation of microwave applicators, which means measurements of SAR distribution in water phantom and measurements of temperature distribution in various types of agar phantoms. Further design and optimisation of measuring probes is discussed, methodology of probes calibration and measured data evaluation are described. Numerical modelling of microwave applicators by aid of software product FEMLAB, comparison of mathematical and experimental models.			
XP17TOM	Theoretical Optoelectronics in Medicine	ZK	5
The course gives to doctoral students from different disciplines the opportunity of both highly theoretical studies and numerical simulations of interactions of electromagnetic waves in the visible part of the spectrum (and adjacent UV and IR bands) with biological tissues. And to learn about modern optoelectronic sensor concepts and their applications in the field of medical therapy and diagnostics. Interdisciplinary topics will be discussed and focused on the benefits and current applications of optoelectronics in medicine. Important definitions (such as radiation intensity, etc.) will be formulated and important methods will be described, in particular: radiometry, photometry, eye as a radiation detection field. UV, VIS, NIR spectroscopy, interferometry, scattering measurements, integration of spherical theory, etc. Emphasis will be placed on modern theoretical approaches (i.e. mathematical and physical models), e.g. calculation of the light intensity distribution in biological tissue, theory of radiation transmission (e.g. theory and model Kubelka-Munk), etc. Students will be acquainted with the possibilities of numerical simulations of the given problems by aid of modern SW products (like e.g. COMSOL Multiphysics, SEMCAD / Sim4Life, CST, etc.) which are working based on numerical methods FDTD, FEM, MoM, Monte-Carlo etc. Operating principle of the optoelectronic reflective and transmissive sensors. Measurement concepts for noninvasive detection of peripheral blood volume dynamics, clinical examples and typical examination tests. Principles and applications of functional optical imaging techniques: optical biopsy, IR Diaphanoscopy, IR thermography, Laser Doppler perfusion imaging (LDPI), Photoplethysmo-graphy imaging (PPGI), optical coherence tomography (OCT).			
XP17TVC	Technique of Highly Sensitive Receivers	ZK	4
Design of highly sensitive microwave receivers, mm - wave and submm - wave receivers. Electromagnetic spectrum and noise properties of the Earth atmosphere and surface. Microwave, millimetre wave communication. Semiconductors for microwave and millimetre wave bands, SIS detectors, mixers, infrared receivers. High frequency radiometers technology, measurement of noise parameters. Multispectral radiometry and remote sensing, electromagnetic radiation - interference, EMC theory and measurement.			
XP31AEO	Electric Circuit Analysis	ZK	4
Circuit models of devices and structures. Methods of analysis and algorithms for linearized circuit models in time domain and frequency domain. Transient analysis. Periodic steady state analysis. Analysis of nonlinear circuits in time and frequency domains. Parametric models. Circuits with non-linear energy storing elements. Circuit analysis with the help of professional software packages.			
XP31ART	Architectures for Real Time Implementation	ZK	4
Architectures of central processing units and synthesis of data paths for DSP. Implementation strategies of DSP algorithms. Influence of algorithm modification on the implementation processing time. Sequential and parallel processing. Numerical characteristics of algorithms. Implementation alternatives, dedicated hardware and programmable signal processors. Architectures of digital signal processors with fixed point and floating points. Developments tools for real time processing. Analysis of real time implementation of FFT, digital filters and special algorithms for communications.			
XP31ASN	Algorithms and Structures of Neurocomputers	ZK	4
Information about the basic principles and possibility of the application of the neural informative technology for the signal processing are the main topic. The lectures are devoted to the introduction into the artificial neural networks (ANN) theory and applications, to the choice and the optimisation of the structures and the neural network applications at the signal processing are investigated in detail. Some neural network applications in the biomedical engineering and hardware realization of the KSOM are described.			
XP31CZS	Digital signal processing	ZK	4
XP31DIF	Digital filter synthesis	ZK	4
LTI systems and digital signals. Impulse response, step response, convolution. Elements of z-transform and Fourier transform. Difference equation, transfer function, magnitude, phase and group delay. Design methods for finite impulse response (FIR) digital filters - windowing and frequency sampling methods, optimal design algorithms. Analytic design of FIR filters, half-band and narrow-band filters. Design methods for infinite impulse response (IIR) digital filters. Bilinear transformation. Analytic design methods in digital z-domain. All-pass sections as building blocks for signal processing. Group delay equalization, phase shift and notch filters. Wave digital filters.			
XP31DSP	Digital signal processing	ZK	4
This course builds on the basic courses of digital signal processing in master's degree, develops and deepens the knowledge corresponding to the needs of doctoral studies in the area of 1-D signal processing. It covers spectral and cepstral analysis, parametric methods, optimal LTI filters, frequency analysis, methods of analysis of relations between time series.			
XP31FON	Speech Phonetics and Advanced Voice Technologies	ZK	4
XP31FSK	Phonetic signals and their coding	ZK	4
The subject introduces the processing of speech signals. Within the subject students should manage from basic to advanced and modern algorithms of speech analysis, synthesis, coding or enhancement. Further reasonable part is focused on speech recognition, where students will get to know modern and advanced technique in task as small and large vocabulary speech recognition or speaker recognition. Special attention is devoted to usage of classification techniques based on GMM, DTW, HMM, ANN/DNN, WFST, JFA, i-vectrors, etc.			
XP31NOS	Design and circuit structures of electronic systems	ZK	4
The course deals with important applications of analogue technique. The subject is divided into the three basic parts. The first part is devoted to amplifiers and analog functional blocks for measurement and signal processing. Special application amplifiers, nonlinear and parametric analog functional blocks and fast analog circuits operating in current mode are also discussed. The second part is devoted to linear analog systems, their characteristics, description and synthesis capabilities. There are discussed: the types of filters and their field of application, methods of filter synthesis and their optimization with regard to real properties and value variances of the circuit elements, implementation of active filters, including discrete-time filters, i.e. switched capacitor (SC) and switched-current (SI) circuits. The last part deals with computer-aided circuit design. The principles of modeling of the analyzed system, including models of functional blocks and circuit elements are discussed together with simulation result processing and their utilization for circuit design and optimization.			
XP31TSS	Signal and system theory	ZK	4
Signals and transformations - Laplace and Z-transforms, Fourier transform, cepstra, wavelet transforms. Signal parameterization - AR, MA, ARMA models, LPC cepstrum. Signal classification - spectral distances, Markov models, neural nets, signal prediction.			
XP31ZBS	Biological Signal Processing	ZK	4
The course deals with the processing of biosignals and advanced methods of processing resulting from current research in solving common projects in cooperation with top institutions (medical faculties, institutes of the ASCR, foreign universities). The subject concept allows us to respond flexibly to new directions and knowledge in the field.			
XP32AKR	Applied Cryptography	ZK	4
Introduction to Cryptography.Mathematics Foundations of Cryptography.Related Problems of Number Theory.Public Key Parameters. Pseudorandom Bits and Sequences. Stream Ciphers. Block Ciphers.Public Key Enciphering. Hash Functions and Data Integrity. Entity Identification and Autentication.Digital Signatures. Key Management Protocols.Key Management Techniques.Effective Implementations of Supporting Algorithms. Patent Pendings and Standards.			
XP32DKS	Sizing of communications networks	ZK	4
XP32DZS	Digital Signal Procesing in Telecommunications	ZK	4
XP32MOS	Mobile Networks	ZK	4
The course familiarizes students with evolution and standardization of mobile networks and mainly provides a detailed description of network architectures and discusses basic principles used in mobile networks. The course as well depicts trends and the future development of mobile networks.			
XP32NMR	Numerical Methodes of Electromagnetic Tasks Solution	ZK	4
The subject deals with analysis of electromagnetic field distribution through both air and other environment. It offers a view deep inside to popular numerical methods as Finite Difference Method, Boundary Element Method and Finite Element Method. Handling the software is obvious nowadays; nevertheless, the mayor attention is paid to understanding the mathematical background of the used apparatus and understanding the physical principles of the solved tasks in symbiosis to particular used software.			

XP32ODV	Intellectual property protection	ZK	4
This subject introduces the basic issues of intellectual property (IP) protection. Students learn why it is necessary to protect research results, how they can protect their own technical solutions and designs, how to obtain a trademark and also how to succeed with IP protection at the international level. The course also deals with license granting procedures for particular protection methods as part of a standard way of commercializing original IP. Emphasis is put on quality methodology for database searching, which is key for successful research and development projects. Motto: Those who do not protect the results of their research work can never dream of being on par with the best...			
XP32OSY	Optical Systems	ZK	4
Optical transmission systems are being more extensively used in a practice, particularly in a telecommunication networks. Tremendous transmission capacity and small size offered by a fiber are just two key factors making it attractive. The objective of this subject is to provide students with a more rigorous theoretical background of fiber and transmission systems function.			
XP32RTS	Telecommunications Systems Management	ZK	4
Telecommunications Systems Management is a discipline which deals problems of interactions of technical and business aspects of management of telecommunication networks and services provided.			
XP32TPZ	Teletraffic Theory	ZK	4
The aim of the course is to present an overlook of dimensioning of telecommunications networks on the basis of results of the queuing theory (QT). Introduce possibilities of simulation and modeling networks both from the point of view of grade of service GoS and quality ofservice QoS as well. Results of the QT are applied on different service systems and telecommunication networks deploying and operating at time being. Theoretical knowledge about models of service systems can be utilized for dimensioning of different service systems in real life - not only in the telecommunication.			
XP33BID	Bionics	ZK	4
Relationship: biology + technology = bionics. Bionics Classification. An overview of biological principles and its technological parallels: reproduction, growth, movement, breathing, heart action, digestion, excrementation, thermoregulation, vision, hearing, taste, smell, sense of touch, speech, memory. Neural and neuronal systems. Motion control. Biosensors and sensors for robotics. Information transfer in biotechnological systems. Biosystems modelling. Biosystems diagnostics. Orientation and navigation. Functional supports, internal and external substitutes, bioprotheses. Artificial organs and its control. Intelligent interaction and communication in biotechnical systems. Intelligent input and output filters. Support system for creative thinking.			
XP33CHM	Chapters in higher mathematics	ZK	4
The course consists of several deeper results in a few mathematical disciplines. The idea is to help a student to read, with a certain comfort, the monographs in given lines of applied mathematics. The contents of the course are fundamental results (principles) of nowadays mathematics. More specifically, the course concerns the Stone representation theorem for Boolean algebras (as applied in mathematical logics and probability theory), the Banach fixed-point theorem for complete metric spaces (as applied in numerical mathematics), the Tychonoff theorem on compact spaces (as applied in measure theory), the Riesz representation theorem for linear forms in a Hilbert space (as applied in the optimization theory), the Brower theorem for balls in Rn (as applied in linear algebra the Perron theorem), the elements of category theory for a practical man, etc. The asset may be a certain encouragement in a students research.			
XP33DID	Distributed Artificial Intelligence	ZK	4
In winter semester 2023/24 the course runs for the last time. In future years, it will not be opened anymore. Distributed problem solving. Multiagent planning. Cooperation. Coordination. Communication. Communication strategies, message passing. Various AI approaches, case studies. Types of agent behavior. Negotiation. Organizational structuring. Partial global planning. Blackboard systems. Client-server systems. Peer-to-peer systems. Implementation aspects of distributed knowledge-based systems. Learning in multiagent systems. Meta-agent. Agents acquitance models, social knowledge, reflectivity in MAS. Coalition formation, team work. Formal models of agent architecture.			
XP33ECD	Evolutionary Computing	ZK	4
Introduction to evolutionary computing in contrast to classical computing techniques, Genetic algorithms (GA) for optimisation. The Simple Genetic Algorithm (SGA) and its behaviour. GA Convergence, negative phenomena. GA and constrained tasks, special representations. Genetic Programming (GP), relationship to GA. GP typical tasks, GP and machine learning. GA and GP applications. Special methods for improving GA performance.			
XP33FLO	Fuzzy Logic	ZK	4
Basics of fuzzy sets and fuzzy logic. Measures on collections of fuzzy sets. Principles of fuzzy control.			
XP33GAD	Geometrical Algebras	ZK	4
Algebraic structures used in geometry: Groups and linear spaces, ordered groups and fields, othogonal groups, Clifford algebras, etc. Discussion of potentital applications in image processing.			
XP33ICT	Modern ICT for Industry and Smart Grids	ZK	4
XP33IMD	Informatics in Clinical Medicine	ZK	4
Medical data processed by automatized systems. Specific problems of medical informatics. Computer supported documentation in doctor´s work. Hospital information systems. Requirements on information system projects from the point of view of medicine. Introduced hospital information systems. Diagnosis theory, computer aided diagnosis. Knowledge-based systems and their application in medicine. Database systems, biomedical databases. Computers in clinical biochemical laboratories. Computers in metabolic and intensive care. Computer aided therapy planning. Standardiyation and communication between information systems in medicine. Specialized computer networks.			
XP33KHD	Introduction to Game Theory	ZK	4
The course offers a brief survey on classical and contemporary theory of games. It includes the elements of the utility theory, decision-making theory, solution concepts of non-cooperative games (balance and minimax) and the basic concepts of coalition games, especially its solutions (core and value) and relation to the market models.			
XP33KSI	Sotware Engineering - Selected chapters	ZK	4
XP33LPD	Logic and Logic Programming	ZK	4
Mathematical logics and its relation to technical disciplines. Formal system and its essential properties - validity, completeness. Syntax and semantics, basic definitions. Compactness theorem. First order language and its interpretation. Theory and its model, Herbrand´s model. Herbrand´s theorem, Gödel´s completeness theorem and their practical implications. Limits of computability and probability. Logic programming and Prolog language. Metodology of logic programming. Introduction of extralogical features and metapredicates. New trends - constraint logic programming (CLP)and inductive logic programming (ILP). Some practical examples of complex logic programs and practical applications.			
XP33MAD	Mathematical Analysis of Dempster-Shafer Theory	ZK	2
Dempster-Shafer theory (DST) presents a model for uncertainty quantification and processing in knowledge-based systems. The belief function, which is the main numerical characteristic of uncertainty introduced and investigated in this theory, can be taken as a generalization of probability measure. The model of DST will be presented. Generalizations to infinite spaces will be also explained as well as to the case when only a fragment of the outcoming knowledge demanded by the classical DST is at our disposal. Belief function taking non-numerical, in particular, Boolean values will be also briefly mentioned. The intended goal of the course is to offer a solid basis for the practical and critical applications of DST in various fields of application oriented toward decision making under uncertainty.			
XP33MKD	Mathematics for Cybernetics - Selected Topics	ZK	4
Overview of modern mathematics. Ordering, lattices, Boolean algebras, representations. Topological spaces. Metric spaces, completeness, fixed-point theorem with applications, fractals. Linear spaces, constructions with linear spaces. Systems of linear equations, spectral theory. Matrix calculus, matrix inequalities. Least squares and singular value decomposition. Tensor product. Elementary theory of Hilbert spaces. Introduction to category theory.			
XP33MMD	Analysis and visualization methods for medical data	Z,ZK	4

XP33MOL	Modal Logics for Distributed Systems	ZK	4
A model of knowledge in distributed environment and "muddy children puzzle". Introduction of modal operators and their semantics based on possible-worlds model. Properties of knowledge. Correspondence between axioms and properties of possibility relation in the model. Knowledge in MAS. Common knowledge and agreement.			
XP33MZT	Management of Knowledge and Information Technologies	ZK	4
Systematic approach to the design of knowledge-based and information systems. Configuration of information systems. User interfaces, especially cognitive interfaces. Problem solving methodology. Analysis of the problem solving processes based on description of the workflows. Simplification of the processes by the support of IT (Process Re-engineering, Concurrent Engineering). Models and tools for modelling. IT applications in enterpreneurship as well as in the project management. Business Intelligence. Value chains: links among suppliers, manufacturers and customers. E-commerce. Role of knowledge in globalization of businesses. Virtual enterprises and organizations.			
XP33NUM	Numerical Analysis	Z,ZK	4
The course introduces to basic numerical methods of interpolation and approximation of functions, numerical differentiation and integration, solution of transcendent and (ordinary and partial) differential equations and systems of linear equations. Emphasis is put on estimation of errors, practical skills with the methods and demonstration of their properties using Maple and computer graphics.			
XP33OSD	Real Time Operating Systems	ZK	4
Hardware support for operating systems, system and user modes, memory protection, operating systems (OS) classification and types, special requirements of real-time applications. OS structure, system processes and application programs, kernel and its services, system calls. Concurrent processes and threads, inter-process communication, process synchronization. Client-server architectures. Process scheduling, scheduling in single- and multiprocessor systems. Processor management, process creation and termination, parent-child synchronization. File management, file system functions, disk allocation strategies, device drivers. Inter-process communication (IPC), IPC based on shared memory and pipes. Resource allocation, time errors, errors detection, critical section, deadlocks. Synchronization tools: semaphores, monitors, looks, deadlock detection and prevention. OS kernel components for internetworking, TCP/IP.			
XP33PAD	Probabilistic Algorithms	ZK	2
A survey of basic notions of statistic and probability. An analysis of the notion of non-deterministic algorithm. Effectivity criteria for non-deterministic algorithms. Theoretical apparatus of probabilistic algorithms. The probability of failure. Loss function. The expected risk. Probabilistic analysis of deterministic algorithms. Criteria for application of probabilistic algorithms. Probabilistic algorithms and their practical importance.			
XP33PAM	Industrial application of multi-agent systems	ZK	4
XP33PMD	Probabilistic Models of Uncertainty in AI	ZK	4
Basic (discrete) probability. Foundations of graph theory. Triangulated graphs and their characteristics. Information as a measure of dependence. Conditional independence (Factorization Lemma, Block Independence Lemma). Knowledge representation by multidimensional distributions. Qualitative knowledge represented by dependence structures. Graphical Markov models and Bayesain networks. Decomposable models for computation in Graphical Markov models. Examples of application.			
XP33POS	Fundamentals of Possibilistic Measures	ZK	4
Possibilistic measures present a mathematical tool for uncertainty (randomness) quantification and processing applying the notions and apparatus of the so called fuzzy sets. They are alternative to probabilistic measures in the sense that they are based on the maxitivity priciple in spite to the additivity principle applied in the standard measure and probability theory. Because of the fact that the operation of maximum (supremum) can be defined also in certain non-numerical structures, possibilistic measures taking their values in partially ordered sets and, in particular, in complete lattices, are worth being investigated. The lecture will not suppose any preliminary knowledge in fuzzy set theory, lattice theory or the standard measure and probability theory.			
XP33PPD	Practical Data Mining Problems	ZK	4
The course is focused on solving of practical data mining problems. Lectures deal with data transformation, pre-processing and verification, selection of a suitable data mining algorithm and data mining process evaluation and results interpretation. The attention is paid to solving of an individual data mining problem based on real-life data under supervision of the lecturer.			
XP33PUD	Artificial Intelligence	ZK	4
Natural language communication with a computer, phases of processing, syntactic analysis, grammars including DCG. Understanding a sentence, semantic support of analysis and efficient memory organization. Knowledge engineering and knowledge elicitation. Machine learning -review of methods and tools. PAC learning. Learning in 1st order logic, ILP. Planning and scheduling.			
XP33RCV	Reading group in Pattern Recognition and Computer Vision	ZK	4
The course deals with fundamental results in computer vision and pattern recognition. It targets the detailed study of principles which substantially influence the development in the field. The course is performed in the form of a reading group. Each time, a person in charge presents a paper and the reading group participants join in with questions, comments and discussion about the paper.			
XP33RG2	Reading Group	ZK	4
This is a reading group type course, where the student should get acquainted with important scientific articles in their field through critical analysis and moderate discussion. Students will each present one or more articles.			
XP33RMD	Control of Mobile Robots	ZK	4
Design of Intelligent Mobile Robots. Known Control Architectures. Top-Down and Bottom-Up Approaches. Overview and Comparison. Distributed Autonomous Motion Control. Modelling. Realisation. Neighbourhood Mapping. Needed Sensors. Ground of Ethology. Imprinting. Taxe. Stimuli, Receptors. Multiple Motivated Behaviour. Reactive and Planning Behaviour. Integration. Community Robots Structure. Task- or Behaviour-Oriented Robots. Ways and Realisation of Robots Co-operation, Motivation, Observation, Perception, Communication and Imitation. Multi-Agent reinforcement Learning. Q-Learning. Action Selection Mechanism, Learning Method, Exploration Strategy. Emotional Learning. Evolutionary Approach to Synthetic Biology. Artificial Life. Virtual World Different Approaches. Robots Competition, RoboCup, Strategy Selection, Implementation. Open Problems.			
XP33ROD	Pattern Recognition	ZK	4
See https://cw.fel.cvut.cz/wiki/courses/xp33rod/start			
XP33ROZ	Selected Topics in Pattern Recognition	ZK	4
Prerequisites: basic course in pattern recognition (e.g. P33ROD, 33RPZ). Selected topics: Anderson's problem, Kozince algorithm, kernel perceptron, nonlinear Fisher discriminant. Vapnik's learning theorz. Deterministic learning. Unsupervised learning: Robbins algorithm and emprirical Bayesian approach. Expectation-minimization algorithm. Recognition of sequences and directed acyclic graphs. Markov models. Combination of weak classifiers: boosting and bagging. AdaBoost.			
XP33RSK	Robust Statistics for Cybernetics	ZK	4
Statistical methods are basic tools of control and decision making theory. Classical statistical methods (e.g. MLE) are usually very sensitive to deviations from our idealized model. Thus many methods which are robust have been developed. It means that these methods are not so sensitive to small deviations from an underlying model. So we briefly explain the parametric concept of estimation and then we introduce the robust approach, some basic robust estimators of location (e.g. trimmed mean, Hampel estimator) and measures of robustness (influence function, breakdown point).			
XP33RSP	Management of Software Projects	ZK	4
XP33SCD	Man-Machine Systems	ZK	4
History of man-machine systems development. Human operator tasks. Manual control, supervisory control cognitive control. Typical structure of a control system. Distribution of priorities in control between operator and machine. Control levels after Rasmussen. Skill based, role based and knowledge based operator behavior models. Fuzzy models. Cognitive models. Operator psychology. Mental models. Human-machine interaction. Intelligent interface. Factors influencing operator behavior. Stress. Mental load. Human error detection. Man-machine system reliability. Man-machine systems simulators. User-centered system design.			

XP33SDD	Discrete Event Systems	ZK	4
Introduction to discrete event systems. Modeling of discrete event systems, GRAFCET and it is applications with practical examples. Petri nets overview. Properties of Petri nets and relations to real systems. Reduction methods, formal languages and algebraic description of PNs. Timed PNs and modeling in P- and T-timed PNs. Practical examples and applications in CIM systems.			
XP33TPS	Foundations of the Possibilistic Measures	ZK	4
Possibilistic/posibility measures can be sen as an alternative mathematical model for uncertainty quantification and processing, topical and intensively developed in our times. They are based on the maxitivity principle replacing the additivity principle applied in the classical measure theory. Besides the real-valued possibilistic measures also non-numerical possibilistic measures taking their values in complete lattices will be introduced and analyzed.			
XP33TTM	Text mining	ZK	4
XP33UID	Artificial Intelligence	ZK	4
Basic terminological issues. Knowledge representation: production systems, predicate logics, semantic nets, frames, and scenarios. Problem solving, state space search. Admissibility and informedness of the search algorithms. Expert systems for diagnostics and planning tasks. Uncertainty processing. Hajek's algebraic theory. Creation of knowledge bases. Knowledge acquisition, induction from examples. Distributed expert systems with the blackboard architecture, multi-agent systems. Backgrounds of pattern recognition.			
XP33VID	3D Computer Vision	ZK	4
Introduction to perspective geometry, perspective camera. Fundamental and essential matrices, their robust estimation, camera calibration. Correspondence problem, structure from motion. The stereoscopic vision problem, cyclopean representation, disparity, disparity gradient limit, ordering constraint, four basic formulations of the dense correspondence problem. Surface model reconstruction from stereovision, error propagation, examples. Physics of image reflection, image irradiance equation, basic reflectance models. The shape from Lambertian shading problem. Local shading analysis. Overview of other Shape-from-X methods. Up-to-date info at https://cw.felk.cvut.cz/doku.php/courses/xp33vid/start			
XP33VTP	Computer Vision Theory and Practice	ZK	4
In the course, the PhD students will study selected sophisticated state-of-the-art computer-vision methods that have an efficient implementation publically available. The course will focus on general methods that have been successfully used in a number of applications, including large scale search in high-dimensional spaces, deep neural networks, and the graph labelling algorithms. The methods selected for the course evolve based on the current progress in the field; the selection is also alternated by the students interests. The goal for the students is to understand the method, to understand the implementation, and to be able to use the implementation as a tool to solve other problems.			
XP33ZDD	Processing of Biological Data	Z,ZK	
XP33ZPM		ZK	4
XP33ZVD	Introduction to Computer Vision	ZK	4
The subject does not exist anymore. Its last lecture run in the academic year 2021/2022.			
XP34ADM	Principles and Applications of Device Models	ZK	4
Fundamentals of the computer-aided technological design. Device simulators Silvaco Atlas and Synopsys Quantum ATK: principles, applications. Basic equations. Boundary conditions. Numerical methods. Recombination models. Avalanche ionisation models. Mobility models. Practical exercises (individual projects) according to the tasks of students' individual theses.			
XP34AIC		ZK	3
Functional structures of the IC's. Bipolar and unipolar structures. BiCMOS structures. 3D structures. Sub-micron structures. Memory structures. Testing structures. VLSI technological processes. Advanced semiconductor technology. IC design, design of technology. Design rules. Reliability, yield. Outlooks and limitations of IC development			
XP34APD	Advanced Power Semiconductor Devices and ICs	ZK	4
Physical and technological structures. Development trends. Parameters and applications. Bipolar structures. MOS structures. BiMOS structures. PN diodes. Schottky diodes. Bipolar transistors. MOS and IGBT transistors. Thyristors (including GTO and MCT). Secondary breakdown, mechanism, safe area. Smart-power devices. High voltage ICs, operation, principles, applications			
XP34ASD	Physics of Advanced Semiconductor Devices and Materials	ZK	4
Modern semiconductor devices and integrated circuits are based on unique energy band, carrier transport, and optical properties of semiconductor materials. Students will be prepared to choose these properties for operation of semiconductor devices. Emphasis is on quantum mechanical foundations of the properties of solids, energy bandgap engineering, semiconductor statistics, semi-classical transport theory (Boltzmann transport equation), carrier scattering, electro-magneto transport effects, high field ballistic transport, optical absorption, and radiative and non-radiative recombination. These princliples will be studied on the experimental basis as well. Students will prepare own structures according their thesis subjects and they will characterise them during their individual projects			
XP34AT	TCAD Tools Applications	ZK	4
Fundamentals of the computer-aided technological design. Device simulators Atlas and Sentaurus: principle, applications. Basic equations. Boundary conditions. Numerical methods. Recombination models. Avalanche ionisation models. Mobility models. Hands-on exercises on SUN workstations according to the tasks of students' individual theses.			
XP34CNO	Integrated Optics	ZK	4
Theoretical and technological principles of IO Basic materials for IO. Light propagation in waveguide structures. Methods of waveguide structure design. Prismatic and graticule coupling elements. Graticule structures. Modal spectroscopy. Fundamental physical effects and interactions for IO. Preparation of dielectric waveguides and structures. Passive waveguide structures. Electro-optical modulators. Applicable measurement methods. Devices based on nonlinear effects. Semiconductor integrated opto-electronic structures.			
XP34DTM	DIAGNOSTICS AND TESTING IN MICROELECTRONICS	ZK	3
XP34EHA	Renewable Energy Microsources for Electronics - Energy Harvesting	ZK	4
The course deals with system integration applied in the design of digital and analog systems with application of system engineering, in i tis solved interconnection of various types of modern electronic systems on a chip as well as external. The course shows new possibilities of realization and application of integrated micro-components working with various physical principles and quantities using mainly MEMS technology, increasing reliability with all its attributes. The course introduces modern elements - microactuators with various principles of their activities including basic applications in industry, medicine, regulation, automotive control, etc. Basic elements of nanotechnology and nanoelectronic structures are mentioned here. The subject extends students' expertise with the latest multidisciplinary chip elements and their wide use in information technologies, IoT, biomedicine, aerospace, automotive industry etc.			
XP34ETS	Electrical Transport in Semiconductors	ZK	4
Electron and hole transport in semiconductor crystals. Effective mass, mobility Boltzmann's transport equation. Scatter mechanisms, frequency. Scattering on phonons, ionised impurities, velocity saturation. Relaxation time approximation Carrier transport in a strong electric field, velocity saturation. Carrier transport in magnetic field. Carrier transport in nanometre structures. Quantum transport, density matrix, Green's and Wigner's functions. Resonance tunnelling, transport of electrons in superlattices. Single electron transport, Coulomb's blockade. Ballistic transport. Quantum Hall's effect. Simulation of transport effects.			
XP34IO	Integrated Optics	ZK	4
Light propagation in waveguide structures. Methods of waveguide structure design. Waveguide coupling elements. Gratings structures at waveguides. Fundamental physical effects and interactions for IO. Design and preparation of dielectric and polymer waveguides and structures. Optical waveguide gratings. Passive waveguide structures. Electro-absorption, electro-optical and thermo-optical effects and their use for IO. Structures for control of optical radiation. . Devices based on nonlinear effects. Semiconductor integrated structures, optical amplifiers. Optical components for informatics and sensors, multiplexing and optical processing. Applicable measurement methods, principles of nanophotonics and integrated optics application.			

XP34MSA	Microsystems and Microactuators	ZK	3
The course deals with system integration applied in the design of digital and analog systems with application of system engineering, in i tis solved interconnection of various types of modern electronic systems on a chip as well as external. The course shows new possibilities of realization and application of integrated micro-components working with various physical principles and quantities using mainly MEMS technology, increasing reliability with all its attributes. The course introduces modern elements - microactuators with various principles of their activities including basic applications in industry, medicine, regulation, automotive control, etc. Basic elements of nanotechnology and nanoelectronic structures are mentioned here. The subject extends students' expertise with the latest multidisciplinary chip elements and their wide use in information technologies, IoT, biomedicine, aerospace, automotive industry etc.			
XP34MSY	Microsystems	ZK	4
Fundamental concepts and classification of microsystems. Micro-sensors. Micro-actuators. Signal processing within the system. MEMS (micro-electrical-mechanical structures). MOES (micro-optical-electrical structures). MEMOS (micro-electrical-mechanical-optical structures). Microsystem design. Microsystem modelling. Manufacturing technologies. Materials. Industrial applications. Medical applications.			
XP34MTP	Materials and Technologies for Photonic Devices and Structures	ZK	3
The students get acquainted with optical materials such as semiconductors, optical glass, crystals, and polymers. The students get acquainted also with technologies for the fabrication of optical and optoelectronic devices and structures. It will be present technologies for deposition of the micro and nano layers deposition. Students will be introduced to new modern technologies and it will be shown principles of integrated optoelectronic devices and structures. It will be also shown the design of the photonic structures and diagnostic methods for the measurement of the optical and optoelectronic properties.			
XP34ORD	Optical Radiation Detection and Detectors	ZK	4
Spectrum of electromagnetic radiation, radiometric and photometric units. Detection of optical radiation. Ideal detectors, internal and external photo-effect. External photo-effect detectors, photomultipliers. Internal photo-effect detectors, PN junction. PIN photodiode, physical principles, properties. Avalanche photodiode, physical principles, properties. Photo-resistors, physical principles, properties. Thermal energy conversion detectors. Bolometers, thermocouples. Pyroelectric detectors. Some other detector types. Optical receivers, design principles, properties, noise. Solar cells, properties. Measurement methods, applications.			
XP34PED	Advanced Electronic Devices	ZK	4
Energy band engineering. Quantum well, wire, point. 2D electron gas based devices (HEMT, MOD FET). Devices based on resonance double-barrier tunnelling. 3D structures. Quantum device applications (memories, generators, multipliers). Heterogeneous structures. Microwave devices, HBT, Gunn diodes. Microwave device applications. Heterogeneous devices with internal optical coupling. Cryotronic devices. Recording media. IC development trends.			
XP34PIC	Programmable IC Design	ZK	4
The aim of the course is to acquaint students with advanced methods of design, synthesis and verification of programmable systems and systems with high integration on the chip. Students will learn the basic building elements, architecture and design procedures used to implement complex integrated systems, methods of describing them, and procedures their synthesis. They will learn verification strategy, design and analysis of tests. This project-oriented course would with the use of state-of-the-art EDA tools to implement a comprehensive programmable integrated system whose application would be linked to the topic of the dissertation.			
XP34RSD	Radiation Saurces and Photodetectors for Integration	ZK	4
The students get acquainted stimulated emission in semiconductors. Homogeneous and heterogeneous junction, double heterostructure laser. Waveguide resonators, DFB structures. Complex lasers, quantum wells. Electromagnetic fields in semiconductor lasers. Types of lasers and their properties. Tunable injection lasers. Spectral line width and line stability. Radiating characteristic, coupling the laser to a waveguide. Bi-stable and voltage devices, switches. Non-coherent LED's, super-luminescence diodes. Lasers and non-coherent diodes for optical communications, injection and coherent external modulators. Injection laser amplifiers. Principles of nano-optoelectronic components. Measurement methods, applications. Students will be introduced to new principles of integrated optoelectronic components and subsystems for informatics and sensor technique, design methods and technologies.			
XP34SDS	Semiconductor Structures	ZK	3
The aim of this course is to provide postgraduate students with a deeper and more detailed insight into principles of and properties of advanced electronic and optoelectronic structures. Completion of this course enables doctoral students to deepen the basic knowledge, which they obtained in the bachelor and master stages of study in the field of semiconductor structures and elements. They will be able to solve scientific tasks in electronics and optoelectronics focused on design, analysis and applications advanced electronic and optoelectronic structures. The student will gain deep knowledge of physics principles of PiN and MOS structures, as these dominate the current integrated and power semiconductor technology. The lecture will be further focused on the use of new principles associated with miniaturization and the use of advanced materials. Higher-order phenomena whose knowledge is essential for understanding the current semiconductor devices will be described. It is expected that the course will focus on specific issues according to the interests and scientific focus of the participants.			
XP34SRS	Semiconductor Radiation Sources	ZK	4
Stimulated emission in semiconductors. Homogeneous and heterogeneous junction, double heterostructure lasers and LEDs. Non-coherent LED's, super-luminescence diodes. Electromagnetic fields in semiconductor lasers. Types of lasers and their properties. Waveguide lasers, DFB and BFR structures. SQW and MQW lasers, quantum wells. Tunable injection lasers. Spectral line width and line stability. Radiating characteristic, coupling of the radiation source to a waveguide. Bi-stable and memory elements and switches. Semiconductor injection, waveguide amplifiers and wave convertors. Lasers and non-coherent diodes for optical communications. Measurement methods, applications.			
XP34STV	VLSI Structures and Technologies	ZK	4
Functional structures of the IC's. Bipolar and unipolar structures. BiCMOS structures. 3D structures. Sub-micron structures. Memory structures. Testing structures. VLSI technological processes. Advanced semiconductor technology. IC design, design of technology. Design rules. Reliability, yield. Outlooks and limitations of IC development			
XP34TOS	Technology of Optical Devices	ZK	4
Preparation of optoelectronic materials and structures. Diagnostic and testing methods. Design and preparation of double heterostructures. Preparation of semiconductor waveguides. Preparation of LED's, lasers, photo-resistors. Preparation of QW structures. Design of dielectric waveguide structures. Preparation of dielectric waveguide structures. Design and preparation of optical radiation distributing structures. Design and preparation of optical radiation control structures. Measurement methods. Testing methods. Examples of semiconductor structures. Examples of dielectric structures.			
XP35CCM	Cooperative Control of Multi-agent systems	ZK	4
Cooperative distributed control is a relatively novel and rapidly developing area of control theory and engineering. Instead of centralized, large systems are considered composed of autonomous subsystems, with local computation and communication capabilities. The broad aim is solving classical problems e.g. stabilization, tracking, estimation and optimization, via local communication and team cooperation robust to changes in communication topology and disturbance. Relevant topics of classical control theory are revisited and a brief review of background mathematics needed for the course is also provided. The potential use of multi-agent cooperation in challenging applications involving environment to be controlled or observed is discussed. Theory: Review of qualitative properties of dynamical systems, Motivation for distributed multi-agent systems, Elements of algebraic graph theory, Distributed estimation and control, Consensus and synchronization of linear/nonlinear, continuous/discrete-time systems, Cooperative stability, optimality and robustness, Distributed optimization: multi-player game theory, Interactions with environment.			
XP35CCM1	Cooperative control of multi-agent systems	ZK	4
Cooperative distributed control is a relatively novel and rapidly developing area of control theory and engineering. Instead of centralized, large systems are considered composed of autonomous subsystems, with local computation and communication capabilities. The broad aim is solving classical problems e.g. stabilization, tracking, estimation and optimization, via local communication and team cooperation robust to changes in communication topology and disturbance. Relevant topics of classical control theory are revisited and a brief review of background mathematics needed for the course is also provided. The potential use of multi-agent cooperation in challenging applications involving environment to be controlled or observed is discussed. Theory: Review of qualitative properties of dynamical systems, Motivation for distributed multi-agent systems, Elements of algebraic graph theory, Distributed estimation and control, Consensus and synchronization of linear/nonlinear, continuous/discrete-time systems, Cooperative stability, optimality and robustness, Distributed optimization: multi-player game theory, Interactions with environment.			

XP35ESF1	Estimation and filtering	ZK	4
Methodology: experiment design, structure selection and parameter estimation. Bayesian approach to uncertainty description. Posterior probability density function and point estimates: MS, LMS, ML and MAP. Robust numerical implementation of least squares estimation for Gaussian distribution. Parameter estimation and state filtering - Bayesian approach. Kalman filter for white noise. Properties of Kalman filter. Kalman filter for colored/correlated noise.			
XP35FMC1	Fuzzy modeling and control	ZK	4
In the initial lectures, the control-related fundamentals of fuzzy logic, fuzzy sets, fuzzy operations and relations are covered. Then the methodology of approximate reasoning and its interpretation using a basis of fuzzy rules is explained while deriving various types of inference mechanisms. Fuzzy system is interpreted as a nonlinear mapping, its properties and possibilities for approximation are discussed. These are then exploited for modeling fuzzy systems from measured data using gradient and least-squares techniques. We then cover thoroughly methods of fuzzy clustering analysis using three most popular algorithms: fuzzy c-means, Gustafson-Kessel and Gath-Geva algorithms. We then dedicate the lectures to the analysis and synthesis of Takagi-Sugeno fuzzy systems, that is, systems based on a model that was obtained either by linearizing along a trajectory or method of sections - both approaches are then compared. Careful discussion of various Lyapunov functions is included - quadratic, piecewise quadratic, fuzzy sharing the same segmentation of the state space as the linear submodels. The problems are formulated as convex optimization invoking the frameworks of linear matrix inequalities (LMI) and sums of squares (SOS). Finally, we also show basic design methods for fuzzy adaptive regulators, both direct (backstepping, fuzzy sliding mode control) and indirect (Fuzzy Model Reference Adaptive Control). Similar methods are finally applied for control using neural networks.			
XP35FMD	Fuzzy Modelling and Control	ZK	4
The goal of the subject is to introduce the up-to-date trends and results in the area of modelling and control of nonlinear systems based on fuzzy logic and neural networks. This includes especially analysis and synthesis of Takagi-Sugeno fuzzy systems, utilization of fuzzy systems and neural networks in control of nonlinear systems by approximation of unknown functions appearing in the description of the system, and design of adaptive fuzzy systems both direct and indirect.			
XP35FSC	Flexible Structure Control	ZK	4
The main aim of this course is introduction to methods of modeling flexible mechanics structures in order to optimization of placement of sensors and actuators. The robust control design of space modes will be follow.			
XP35FSC1	Flexible structures control	ZK	4
The main aim of this course is introduction to methods of modeling flexible mechanics structures in order to optimization of placement of sensors and actuators. The robust control design of space modes will be follow.			
XP35LMI	Linear Matrix Inequalities	ZK	4
Semidefinite programming or optimization over linear matrix inequalities (LMIs) is an extension of linear programming to the cone of positive semidefinite matrices. LMI methods are an important modern tool in systems control and signal processing. Theory: Convex sets represented via LMIs; LMI relaxations for solution of non-convex polynomial optimization problems; Interior-point algorithms to solve LMI problems; Solvers and software; LMIs for polynomial mehods in control. Control applications: robustness analysis of linear and nonlinear systems; design of fixed-order robust controllers with H-infinity specifications. For more information, see http://www.laas.fr/~henrion/courses/lmi			
XP35LMI1	Linear matrix inequalities	ZK	4
Semidefinite programming or optimization over linear matrix inequalities (LMIs) is an extension of linear programming to the cone of positive semidefinite matrices. LMI methods are an important modern tool in systems control and signal processing. Theory: Convex sets represented via LMIs; LMI relaxations for solution of non-convex polynomial optimization problems; Interior-point algorithms to solve LMI problems; Solvers and software; LMIs for polynomial mehods in control. Control applications: robustness analysis of linear and nonlinear systems; design of fixed-order robust controllers with H-infinity specifications. For more information, see http://www.laas.fr/~henrion/courses/lmi Výsledek studentské ankety předmětu je zde: http://www.fel.cvut.cz/anketa/aktualni/courses/XP35LMI			
XP35LSD	Linear Systems	ZK	4
This course builds upon the master program lectures on Dynamical Systems Theory. The structure and properties of linear multi-input multi-output systems are studied. The significance of these results for the design of linear controls is demonstrated. The presentation focuses on pole placement techniques, linear state regulation and estimation, and LQG control design. State-space and transfer-function design techniques are compared. The lectures are supported by laboratory experiments using Matlab, Control System Toolbox, and Polynomial Toolbox.			
XP35NES	Nonlinear Systems	ZK	4
This course constitutes a continuation of the master level course "Nonlinear systems" being opened during winter semester. It is devoted to the detailed study of nonlinear systems structure from the control design point of view. It is based on state space descripion of nonlinear systems. Model transformations will be studied to simplify them and thereby faciliate the controllers design. It gives mathematical conditions for the existence of these transformations. Nonlinear analougues of controllability and observability will be introduced and studied as well and their relation to detectability and stabilizability investigated. Finally, elements of nonlinear output regulation as well as of nonlinear robust and adaptive design will be presented. Exercises will be, in particular, based on MATLAB and SIMULINK use.			
XP35NES1	Nonlinear systems	ZK	4
The goal of this course is to help student develop a deeper and broader perspective on theory and applications of nonlinear systems. At the hearth of the course will be the so-called differential-geometric approach, which can be used for controllability and observability analysis of nonlinear systems, characterization of various types of exact feedback linearization and many other tasks. Great attention is paid to analysis of the structure of nonlinear systems from the perspective of control design. It follows from the state description of nonlinear systems and uses state transformations of the nonlinear model into a simpler form that is usable for control design. Differential-geometric conditions for existence of these transformations are studied in this course. Concepts of nonlinear controllability and observability are introduced in this course and their relation to stabilization and reconstruction is analyzed because it is not as clear as for linear systems. Some additional topics such nonsmooth stabilization and discontinuous stabilization will be covered. Examples of use of the presented theories in underactuated robotic walking, nonholonomic systems and optimization of biosystems will be given.			
XP35OFD	Estimation and Filtering	ZK	4
Methodology: experiment design, structure selection and parameter estimation. Bayesian approach to uncertainty description. Posterior probability density function and point estimates: MS, LMS, ML and MAP. Robust numerical implementation of least squares estimation for Gaussian distribution. Parameter estimation and state filtering - Bayesian approach. Kalman filter for white noise. Properties of Kalman filter. Kalman filter for colored/correlated noise.			
XP35ORC1	Optimal and robust control	ZK	4
This is an advanced course about modern control design methods that formulate the design as a mathematical optimization. Besides teaching practical design skills, the course will also help develop deeper understanding of fundamental concepts as well as build awareness of the latest results. Thanks to its background in mathematical optimization, the benefits of the course can certainly be seen beyond the borders of automatic control domain. The course can be viewed as an extension of the equal-named course in the master program (B3M35ORR). However, numerous topics are new and those few topics that already appeared in the master version will be discussed at a significantly deeper level. This time the motivation is not just to give practical tool but also to go through the proofs, discuss various interpretations, and survey the results from the latest literature. From the student perspective, the goal of this course is to acquire advanced competences (knowledge and skills) in the area of computational design of control systems (or rather control algorithms). The methods will almost exclusively assume availability of a mathematical model of the system to be controlled (hence model-based control design). We will consider dynamical systems in continuous as well as discrete time, linear and nonlinear, single and multiple inputs and outputs. Since all the design methods introduced in this course formulate the design task as an optimization, the crucial competences will come from the areas of optimization, both finite-dimensional (linear, quadratic, nonlinear and semidefinite programming) and infinite-dimensional (calculus of variations, operator theory, differential games).			
XP35RRD	Robust Control	ZK	4
Advanced course on selected topics in robust control.			

XP36ASP	Architecture of Symbolic Computers	ZK	4
Symbolic expressions and abstract programs, lambda calculus, formal basis for abstract programming, self-interpretation, SECD abstract machine, memory management, demand-driven evaluation, Lisp implementations, predicate logic and its inference engine, Prolog inference engine and dynamic algebras, Warren abstract machine, optimisation, Prolog implementations, parallel inference engines.			
XP36DRO	Diagnostics and Reconfiguration of Programmable Circuits	ZK	4
The subject is aimed to help PhD students to understand better methods of reliability and availability improvement of SOC and NOC circuits built on FPGAs and ASICs.			
XP36DSV	Distributed Systems	ZK	4
Communication mechanisms - message exchange, procedural communication (RPC, ORB), distributed shared memory. Process algebras - CSP, CCS, and pi-calculus, cooperating automata, Petri nets. Distributed execution, global state, causality, logical time. Algorithms of: exclusive access, leader election, deadlock detection/prevention, termination. Faults, resiliency, qourum algorithms, replication. Mobility, search in distributed systems - DHT.			
XP36DSY	Distributed Systems	ZK	4
Communication mechanisms - message exchange, procedural communication (RPC, ORB), distributed shared memory. Process algebras - CSP, CCS, and pi-calculus, cooperating automata, Petri nets. Distributed execution, global state, causality, logical time. Algorithms of: exclusive access, leader election, deadlock detection/prevention, termination. Faults, resiliency, qourum algorithms, replication. Mobility, search in distributed systems - DHT.			
XP36HS	Hypermedia Systems and Internet Computing	ZK	4
Hypermedia systems, basic models. Intelligent searching, adaptive navigation, personalization of access to web applications. Web intelligence, semantic web. Web engineering, main topics and the ways out. Internet computing. Modern technologies for web applications design.			
XP36JAI	Languages for Artificial Intelligence	ZK	4
The course offers a deep insight into the two programming languages that are most frequently used in the domain of artificial intelligence (Lisp, Prolog). It exhibits programming paradigms used to build typical AI algorithms and gives some basics concerning the implementation of the two languages.			
XP36KP	Communication Protocols	ZK	4
Communication protocol principles, SDL language, protocol architecture: ISO OSI, error control, data-link layer protocols: X.25, higher layer protocols (TCP, TP4), communicating finite state machines, implementation tools (FSM language ESTELLE, regular grammars), use of Petri nets, specification language LOTOS, protocol transformation, design, synthesis, validation and verification of protocols.			
XP36LSM	Logical Simulation	ZK	4
General introduction to simulation: fundamental ideas and principles of simulation systems, synchronous and asynchronous simulation. Simulation system VHDL and its use for simulation of digital circuits: data types, entities, architectures, sequential environment (processes, functions, procedures), signals and their attributes, resolution function, parallel environment (data-flow description, blocks, structural description), configuration of structural models. Students who completed course 36SIM cannot enroll.			
XP36NSN	Neural Networks and Neurocomputers	ZK	4
Theoretical background, paradigm classification and artificial neural networks learning methods. Student is supposed to propose and test the application of an artificial neural network for a partial issue concerning his dissertation theme during the semester. Procedure and results would be concluded in the preliminary publication form designed to be presentable on a scientific forum.			
XP36PAS	Algebraic Specifications Prototyping	ZK	4
Algebraic specification, syntax and semantics of a specification language (OBJ3), structured specifications, generic specifications, implementation of an algebraic specification, interpretation using Prolog, translation into Lisp, term rewriting systems, abstract rewriting machine, prototyping of a specification, prototyping in OBJ3, conversion to procedural language (C++).			
XP36POA	Advanced Parallel Algorithms	ZK	4
Design and analysis of time-, and cost-efficient PRAM algorithms and parallel algorithms for distributed memory machines. The collection of algorithms includes: advanced parallel scan algorithms, distributed list ranking, Cole's MergeSort, optimal mesh sort, connected components, tree contraction and tree evaluation, pattern matching in texts.			
XP36PSV	Parallel Systems and Algorithms	ZK	4
Complexity measures and scalability of parallel algorithms. Parallel computer architectures, models, PRAM, APRAM. Direct and indirect interconnection networks, embeddings, simulations. Communication algorithms - routing, switching techniques, deadlock problem, permutation routing, collective communication operations. Fundamental parallel algorithms - reduction, prefix computation, Euler tour technique. Parallel sorting. Parallel linear algebra algorithms. Parallel combinatorial search. Parallel complexity theory Graduates of engineering studies in specialization Computer Science and Informatics FEE CTU cannot register.			
XP36RSY	Reconfigurable Systems	ZK	4
Systems that have reconfigurability as a part of normal function. Technology of reconfiguration., partially reconfigurable devices. Reconfiguration control and management, collaboration with operating systems, software support. Design and verification of reconfigurable systems, algorithms, EDA tools. Reconfiguration in System on Chip (SoC). Codesign issues in SoC. Seminars, experiments with reconfigurable devices, case study, literature research.			
XP36SEP	Seminars on Architectures of Parallel Computers	ZK	4
Overview of architectures of high-performance computers and trends in technologies. Memory coherence and sequential consistency models. Shared-memory architectures: buses and switches, bus-based cache coherence protocols and synchronization mechanisms. Virtual shared memory architectures: distributed cache-coherence protocols. Synchronization mechanisms - barriers. Clusters: fast communication networks and protocols.			
XP36STR	Stringology	ZK	4
Processing of strings and sequences. General, ordered alphabet. Generalized and weighted strings. Finite and infinite alphabet. Searching in text, dictionaries and languages. Exact and approximate matching. Forward and backward matching. Searching in compressed text. Searching in more-dimensional text. Searching for longest common factors and subsequences. Searching for regularities in text. Construction of covering of text. Representation of text, prefix, suffix and factor automata, suffix trees and arrays.			
XP36VAP	Advaced Computer Architecture	ZK	4
Instruction level parallelism (pipelined, superpipelined and superscalar systems). Basic limitations to parallelism (structural, data and control hazards). Instruction fetch and execution methods (in order, out of order). Register data flow, software and hardware solutions, interlocking, scoreboard, control stack. Memory reuse, register renaming. Modern RISC processors. Parallel systems, performace evaluation, HPCC, supercomputers. Shared memory multiprocessors (bus, switch, switched memory). Interconnection structures. Cache coherence mechanisms for multiprocessor systems. MIMD systems UMA, NUMA, COMA. Distributed memory multiprocessors (crossbar switch). Data flow systems, multithreading. Accelerators, special architectures.			
XP36VAV		ZK	4
XP36VPD	Selected Parts of Data Mining	ZK	4
Data mining aims at revealing non-trivial, hidden and ultimately applicable knowledge in large data. This course focuses on two key data mining issues: data size and their heterogeneity. When dealing with large data, it is important to resolve both the technical issues such as distributed computing or hashing and general algorithmic complexity. In this part, the course will be motivated mainly by case studies on web and social network mining. The second part will discuss approaches that merge heterogeneous prior knowledge with measured data. Bioinformatics will make the main application field here. It is assumed that students have completed the master course on Machine Learning and Data Analysis (A4M33SAD).			
XP37AEA	Applied Electroacoustics	ZK	4
Review of basic equations in acoustics, modeling of miniature acoustic elements in thermoviscous fluid, equivalent circuits based approximation, review of principles of electroacoustic transduction, acoustic transmitters and receivers, waveguides for transducers, membranes and plates in transducers, modeling of coupling between mechanical and acoustical parts in transducers, electrostatic microphones and their models, MEMS microphones.			

XP37AEM	Acoustic and Electroacoustic Measurements	Z,ZK	4
Measurement of acoustic pressure, measuring microphones. Measurement of acoustic impedance. Foundamental audiometric measurements, artificial ear. Measurement of acoustic power. Methods of calibration of measuring microphones. Method of reciprocity. Method of reciprocity in the field of the spherical wave, in the diffusion sound field. Calibration methods for accelerometers and sensors of velocity and displacement. Measurement of mechanical impedance, impedance head, artificial mastoid. Electrostatic transducer and its application for electroacoustic measurements. Measurement of thin membranes and air-gaps. Acoustic intensity measurement. Measurements of acoustic transmitters.			
XP37APF	Acoustics and Electroacoustics of Solid State	Z,ZK	4
Waves in elastic isoptropic unbounded continuum. Wave equation. Scalar and vector potential. Plane harmonic uniform and non-uniform wave. Energy and power in plane harmonic wave. Plane wave in half-space, reflection and refraction of a plane wave at an interface between too solids. P-wave, SV and SH waves. Rayleigh waves. Waves in wave -guides in solids. Wave propagation in cylindrical wave-guide. Solid-state waveguides of non-uniform cross-section. Piezoelectricity. Equivalent circuits of piezoelectric transducers for generation of volume and surface waves.			
XP37AR	Speech Acoustics	ZK	4
Vocal tract, anatomy, physiology. Vocal cords, production of speech. Types of phonems. Speech analysis and synthesis. Automatic recognition of speech.			
XP37ARA	Architectural Acoustics	ZK	4
Wave theory, geometrical and statistical acoustics. Acoustical lining and sound absorption. Objective room acoustic parametres. Subjective criteria for auditory quality of halls. Room acoustics measurement technique. Physical modelling and numerical simulation of sound propagation. Electroacoustic sound reinforcement. Acoustical properties of buildings: absorption of sound, sound insulation. Simple and complex constructions. Criteria for sound insulation properties of building constructions. Measurement in acoustics of constructions. Calculations in room acoustics.			
XP37CAD	Advanced methods for circuit analysis and optimization using computer-aided design	Z,ZK	3
The first part of the subject deals with contemporary models of both classical semiconductor elements (in submicron domain) and special microwave transistors as HBT, pHEMT etc. Moreover, models of power MOS (LDMOS) transistors are also defined and characterizing the elements by X-parameters is included as well. The modeling part of the subject is completed by characterization nano-scale elements, including noise models, and by a description of memristors, memcapacitors and meminductors. The second part of the subject contains algorithms for solving nonlinear stiff systems of differential-algebraic equations in implicit form combined with nonstandard sensitivity analysis in time domain. The sensitivity analysis in the frequency domain is also included as well as nonstandard sensitivity analysis of noise figure. Attention is also given to steady-state algorithms, in particular, their more difficult form usable for autonomous circuits. The analytic methods are naturally complemented by single- and multi-objective optimizations. Up to four-dimensional optimizations are demonstrated on very complicated, but technically useful tasks from the microwave area including power RF amplifiers.			
XP37DRS	Satellite communication and navigation systems	Z,ZK	4
Satellite communication - overview. Systems for fixed and mobile service. Satellite networks: Intelsat, Eutelsat, Inmarsat, Intersputnik, Astra. Orbits (LEO, MEO, GEO, HEO) and parameters of satellite communication channel. Energetic budget of satellite link. Satellite link design. Frequency bands. Modulations and multiplexes: TDMA, FDMA and CDMA. Spread spectrum communication. Systems VSAT, DAMA, DVB-S, S-UMTS. Multimedia satellite services. Satellite navigation systems: GPS, GLONASS and GALILEO. Satellite communication and navigation systems integration - CNS systems.			
XP37ELA	Elastoacoustics	ZK	4
The course deals with interactions of elastic structures with gaseous medium, namely vibrations of plates, radiation impedances, modal equations, influence of walls surrounding acoustic space, finite element method, calculation of eigenfrequencies.			
XP37FHA	Physiological, Psychological and Musical Acoustics	ZK	4
Anatomy of the hearing organ, hearing theory, hearing field, loudness, masking, pitch of sound, temporal tresholds, distortion in the hearing organ, adaptation, fatigue and impairment of hearing system. Binaural hearing, objective and subjective properties of musical signals, statistical and dynamical analysis. Perception of simple tones and complex sounds, consonancy and dissonancy. Psychoacoustics of transmission of the musical signal. Methods of psychoacoustic measurements, their validity, repeatability. Planning and realization of listening tests, methods of statistical analysis of results, interpretation.			
XP37FHA1	Physiological, Pychologycal and Musical Acoustics 1	ZK	4
Properties of musical signal in temporal and frequency domains, methods of sound synthesis, timbre and interpretation of sound spectra, objective assessment of timbre, theory of sound quality, introduction to acoustics of speech and singing, physical.-acoustic principles of musical instruments, tuning, dynamics, timbre of the tone, radiation properties of musical instruments, introduction to methodology of measurement of musical instruments.			
XP37FHA2	Physiological, Psychological and Musical Acoustics 2	ZK	4
Properties of musical signal in temporal and frequency domains, methods of sound synthesis, timbre and interpretation of sound spectra, objective assessment of timbre, theory of sound quality, introduction to acoustics of speech and singing, physical.-acoustic principles of musical instruments, tuning, dynamics, timbre of the tone, radiation properties of musical instruments, introduction to methodology of measurement of musical instruments.			
XP37FOS	Photonic Imaging Systems	ZK	4
Image and its representation. Energetic image description. Principles of image acquisition, transferring and storing. Image entropy function, 2 dimensional autocorrelation curve and probability image description. Novel compression techniques. Image reproduction, matrix description. Light diffraction. 2D transfer functions - PSF, MTF, PSF, MTF of real imaging and detection systems. 2D transfer systems and their signal distortion, image aberration and their correction, toleration analysis of optical system. Receivers and transmitters for special application. Photonic processors, computers and memories.			
XP37FOT	Selected Parts from Photonics	Z,ZK	3
The subject is focused on the overview of recent applied photonic topics esp. integral and panoramic photonics receivers, transmitters and other special elements and subsystems incl. relevant theoretical background. Selected examples of applied photonic elements and subsystems will be demonstrated in lab experiments and results of ESA space projects. Lab exercises will take place in the specialized departmental laser lab for limited number of participants. Selected experiments will also be presented during lectures. The durable equipment purchased under the project frame will be exploited.			
XP37FZS	Fuzzy Signal Processing	Z,ZK	4
PhD students education and their research activities are focused on the problems of utilize fuzzy logic and neural network for optimization algorithm used at numerical signal processing as adaptive filtration, diagnostic of the signal, control phase lock and so on.			
XP37GAB	Genesis and Analysis of Biosignals	ZK	4
The subject deals with genesis and description of the most important biological signals of both electric and non-electric nature. Properties of the biosignal, essential for the consequential signal processing, are studied. Finally, simple and advanced methods of biosignals pre-processing, analysis and evaluation are presented for each the biosignal.			
XP37IAR	Implementation algoritms in radioelecronics	Z,ZK	4
PhD students' education and their research activities are focused on the problems of effective implementation algorithms in radio electronics by signal processors, processors with more arithmetic units (universal and signal processors) and with support hardware accelerators in FPGA circuits. Optimization of the algorithm is concentrate on minimalisation computational complexity by utilization multirate digital signal processing and hardware accelerators.			
XP37IPP	Image Processing and Photonics	ZK	4
Photonics is a basic discipline used in space technology. Students will become acquainted with advanced imaging photonics used in space sciences, including the design and simulation of optical instruments and the influence of the environment. In addition, there are included parts describing the parameters of optical instruments (PSF, MTF, OTF, resolution, SWATH, etc.), waveform deformation modeling and removal methods for IR - VIS electromagnetic radiation. The subject also includes a description of the sensor part of the image, including noise parameters and the reconstruction of the acquired image, and discusses its use in space applications. In addition, there are parts including Earth Remote Sensing, mission design,			

	and the use of modern instruments in this area, including optical Fourier transform, electromagnetic wave polarization research, and hyperspectral imaging and data processing in this area, including image data telemetry.		
XP37ISS	Introduction to space science and technology	ZK	4
	Introduction to space sciences and technology on PhD level. Methods and resources of space research and their applications. Satellites, space probes, space stations, space transportation systems, their development, proposals and design. Optoelectronic systems for space, onboard systems and payload, space communication and navigation, space materials and technology. Remote sensing and multispectral images, applications. Space physics, cosmic environment, cosmic radiation and particles. Ground based segment, tests of space systems, space software, archiving and data reduction, organization international co-operation.		
XP37LN	Aircraft Navigation	ZK	4
XP37MPS	Multimedia Signals Transmission	ZK	4
	Generalized communication system scheme. Extended knowledges in radio transmitters and radio receivers. Radio transmitters and receivers system design. Satellite communication systems. Public cellular radiotelephone systems. Terrestrial and satellite digital broadcasting. Analog and digital radiorelay systems. Metallic communication systems. Noncoherent and coherent optoelectronic communication systems. Modulation and multiplexing in optoelectronic systems. Cable television networks, interactive television systems. Mobile radiocomunications development trends. Electromagnetic compatibility.		
XP37MSC	CNS Modern Systems	ZK	4
XP37MSP	Advanced Multimedia Signal Processing	Z,ZK	4
	The course covers selected areas of advanced multimedia signal processing with emphasis on processing techniques adapted for sensing, processing and reproduction especially of image and video signals concerning the requirements of human observers and the characteristics of human visual system (HVS). Main focus of the course is on visual information coding, including overview of conventional methods in respect to the information theory, rate-distortion analysis and advanced methods for efficient visual information representation in respect to Quality of Experience (QoE) in emerging immersive multimedia. Emphasis is placed on the rigorous theoretical description of the methods but also on the possibility of their experimental verification in the laboratory using special equipment or simulation tools.		
XP37MVP	Scientific Work Methodology	ZK	4
	Targeting and motivation of scientific work, exploitation of literature and other information resources, accessible databases, fundamentals of project preparation, examples of scientific projects, formal requirements (PhD Thesis, article, conference), patents and patent search, Internet exploitation, discussion groups, WWW presentations, project presentation.		
XP37NAV	Navigation systems	ZK	4
	The course is focused on the field of navigation systems and their practical applications. It covers GNSS technology including definition of coordinate systems, explanation of the physical problems associated with satellite navigation, and positioning methods. On the other hand, only one lecture is devoted to the design of GNSS receivers, since the issue of radio receivers is in details described in other master's course Architecture of Radio Receivers and Transmitters. The GNSS area is further extended to the field of inertial navigation including the navigation equations and mechanization of the calculation, inertial sensors and aiding systems/sensors, e.g. pressure based altimeters, magnetometer, Lidars, ultrasonic transducers, radars, etc. The focus is paid on detailed data fusion practical tasks for estimating position, velocity and attitude in outdoor/indoor environment.		
XP37NOS	Advanced Computational Tools for Imaging and Radio Systems	ZK	4
	The course focuses on advanced image and signal processing with a focus on imaging and radio systems. The emphasis is on the implementation of algorithms as well as on individual work in the laboratory. Students will verify the principles of algorithms in solving non-trivial problems, such as processing of image data from wide-field systems used in astronomy, fast processing of large data volume from non-linear image system, 2D photometric system calibration, and real-time GNSS signal processing.		
XP37NRO	CAD for RF and Microwave Circuits	Z,ZK	4
	Current models of semiconductor devices and transmission lines implemented in the PSpice class and similar programs. Hierarchy of the models of other elements of RF and microwave circuits. Enhancing the model accuracy with artificial neural networks (ANN). Advanced algorithms for analysis and optimization of RF and microwave circuits. Model parameter extraction.		
XP37ODS	Optical Design and Simulation	ZK	4
XP37PAC	Physiological Acoustics	ZK	4
XP37PKP	Biomedical Engineering in Clinical Practice	ZK	4
	Solving methods of practical problems that a biomedical engineer has to overcome in the clinical practice. Position of BME in research and in the clinical practice. Guidelines for animal and clinical experiments - design, conducting and evaluation, statistical analysis used in medicine. Thermodynamics of gas mixtures. Humidification of ventilation gases. Evaporisers of anaesthetical substances. Systems with compressible fluids. Measurement of physical parameters in rigid and compliant systems. Basic parts of pneumatic systems in medicine (jet generators, generators of airflow and pressure, gas blenders, etc.). Modelling and analysis of biological systems using electrical analogy, practical applications. Analysis of body fluids. Electrochemical, optical, biochemical sensors. Haematology analysers. Interference, corrections of measured values, standardisation in medicine. Electrostimulation. of internal organs and skeletal muscles. Electrodes and circuits for biopotential measurement and electrical stimulation. Indirect measuring methods of biological and physical values.		
XP37RAD	Radioelectronics	ZK	4
XP37RUP	Radio determination of position, theory and practice, experience	Z,ZK	5
	The main aim of the subject is to acquaint a doctoral student with receiver position determination methods in systems using different measurements and position determination algorithms (least-squares methods ...) and with their accuracy. The student will study error magnitude derivation and will get information concerning the choice of compromises between convergence rates and precision. It will be revealed that massively used satellite navigation methods suffer from many deficiencies under real environment conditions. It will be shown how the impact of these weaknesses can be reduced by the assistance from other sensors based on radio as well as non-radio principles. Moreover, there are very prospective methods of positioning based on Signals of opportunity processing; they are included in the course, too. The student will verify the achieved results by individual laboratory project exploiting instrumental equipment like a signal generator with simulator of satellite signals and generators of communication signals (DVB-T, LTE). The acquisition of the equipment was supported by the development project OP VVV.		
XP37SFA	Fundamentals of Physical Acoustics	ZK	4
	Classical theory of elasticity, Carthesian tensors. Theory of small deformations, dynamic equations of isotropic elastic medium. Microscopic model of fluids. Cinematics of fluids. Dynamics of vascous fluids. Stationary flow of vascous fluid.		
XP37SRP	Radio Receivers Special Technology	ZK	4
	Introduction to advanced radio receivers technology. Basic structure classical and modern software defined radio receivers. Technical parameters radio receivers. Specific features radiobroadcasting and television receivers. Professional radiocommunication receivers and transceivers. Diversity techniques. Spread spectrum radio receivers. Low noise narrowband and broadband amplifiers. Oscillators and frequency synthesizers. Mixers and demodulators. Radio receivers system design.		
XP37SZS	Statistical Signal Processing	Z,ZK	4
	Parameter estimation and detection theory. General properties and fundamental limits. ML, LS, Bayes (MAP,MSE), NP, MM estimators and detectors. Adaptive filter theory (Kalman, RLS). Iterative detection and parameter estimation.		
XP37TAS	Acoustic signal processing and theory	Z,ZK	4
	Acoustic signal classification, sources, description of properties. Statistical analysis of acoustic signals. Spectral analysis of signals, Fourier transform application. Time-frequency analysis, Short-time Fourier Transform, Wavelet transform, Wigner-Ville distribution. Cepstral analysis and its application in acoustics. Discrete signal processing and its effect to sound perception. Oversampling, noise shaping . Granulation noise, dithering, signal requantization. Acoustic signal acquisition and data pre-processing. Impulse measurements of electro-acoustic systems. System analysis using swept and time delayed acoustic signals. Pseudorandom signals and their application in acoustic system analysis. Digital processing of musical signals.		
XP37TEA	Theoretical Eletroacoustics	Z,ZK	4
	Vibrating systems in fluids and solids. Systems of lumped and distributed parameters in solids. Equivalent circuits of membranes and plates. Reciprocal transducers with magnetic and electric field. Non-reciprocal transducers (opto and thermoacoustical transducers, piezoresistive transducer). Electromechanical and electroacoustical transducers with lumped and		

	distributed elements. Radiation, radiation impedance. Acoustic transmitters, directivity. Acoustic receivers. Acoustical systems with lumped and distributed elements. Acoustic waveguides, air-gaps. Coupled systems.		
XP37TEM	Theoretical Electroacoustics and Measurement	Z,ZK	3
	The course is aimed at selected parts of electroacoustics and related fields with the emphasis on the theoretical aspect. The main interest lies in electroacoustic transducers and their parts. Their description will include non-linear mode. The part on measurement will include mainly calibration methods and their usage in cases close to topics of theses of doctoral students.		
XP37TMP	Medical Instrumentation	ZK	4
	The subject deals with principles and properties of medical systems for analysis of body fluids, blood gas analysis, medical minors of basic life functions (ECG, pulse oxymetry EEG, etc.), thermodynamic principles of anaesthetic equipment and equipment for artificial lung ventilation, haematological analysers and other medical apparatuses.		
XP37VKF	Selected Parts from Photonics	ZK	4
	Anatomy and physiology of vision. Integral photonic sensors. Panoramatic (image) photonic sensors. Integral photonic displays. Panoramatic photonic displays. Electron optics. Image converters. Special photonic elements. Basic elements of optical systems. Fundamentals of illumination. Fiber-optics elements and systems. Optical methods of information processing. Optical (photonic) processors.		
XP37VRA	Research Seminars in Radioelectronics and Acoustics	Z,ZK	4
	The course is intended for PhD students of the radioelectronics and acoustics specialization. It develops the presentation skills and serves as a platform for discussion and defence of students' research results.		
XP37ZI	Information recording	Z,ZK	4
	Magnetic recording theory. FM signal recording. Video information recording systems. High density recording, tape recorder thin heads. Impulse recording and reproduction. Digital recording on CD-audio, DAT. Digital recording on CD-ROM, CD-video. WORM, CD-R recording. Erasable magneto-optical recording on MD. Digital video recording. Coding, data compression.		
XP37ZSN1	Signal processing in satellite navigation systems 1	Z,ZK	4
	Distance measurement with pseudorandom signals and with carrier. Position determination based on measured distances. Time delay discriminator. Schema of range navigation receiver. GDOP, PDOP, HDOP, VDOP. GPS system, precision. Glonass and its precision. GALLILEO. Comparison of these systems.		
XP37ZSN2	Signal processing in satellite navigation systems 2	Z,ZK	4
	Doppler satellite navigation systems, structure of receiver and precision of position measurement. Shortcomings of satellite systems: limited access and integrity, RAIM and GIC, augmentation. Differential systems DGPS and DGLONASS, RTCM-104 standard. Systems SKY-FIX, FUGRO, RACAL, WAAS, EGNOS. GALILEO and its prospective. GPS III.		
XP38ATM		ZK	3
	The subject introduces the principles and technical means of data acquisition in the laboratory and industrial environment. Attention is paid to both hardware and software aspects of the integration of systems for data acquisition and process control. Laboratory exercises are designed in part in the form of classical tasks, partly in the form of problem-oriented tasks in the field of programming of automated measurement systems and control of measurement processes.		
XP38EMC	Electromagnetic Compatibility of Data Acquisition Systems	ZK	4
	EMC - basic terms. Measurement of electromagnetic emission and immission. EMC standards. Modelling of disturbing signals. Electromagnetic disturbance in laboratory and industry. Design of DAQ systems with regard to EMC. EMC of data transmitting lines.		
XP38MDR	Methods of Signals Digitalization and Reconstruction	ZK	4
	The up-to-date and unconventional methods of analog preprocessing of typical sensors signals, selection of optimal digitization methods and optimization of hardware solution including of processing of measurement results to achieve high accuracy and effective suppression of disturbing signals.		
XP38MET	Metrology	ZK	3
	The course is focused on solving problems connected with the metrology of electrical quantities and application of modern tools to it. The lectures acquaint students with the up-to-date methods of precise measurement of electrical quantities with an accent to correct evaluation of accuracy.		
XP38MMN	Measurement of Nonelectric Quantities	ZK	4
	Physical principles of sensors. Measurement of temperature, pressure, flow, movement, position and other physical quantities. Chemical sensors and analyzers, biosensors, metal detectors, detection of explosives. New types of signal conditioning circuits. Sensor Applications in industry, transport and consumer electronics. Security and military applications. Sensor design and technology. Signal processing in sensor systems, intelligent sensors.		
XP38MPM	Methods for Precision Measurement of Electrical Quantities and Measurement Data Processing	ZK	4
	Quantum standards of electrical quantities. Collective standards. Inductive ratio devices for precision electrical measurements and possibilities of improving their metrological parameters. Modern methods for precision measurement of active and passive electrical quantities. Evaluation of measurement errors and uncertainties. Metrological reliability. Statistical analysis of measurement data.		
XP38MPX	Magnetism in Engineering Practice	ZK	4
	Students will be introduced into the magnetic materials, magnetic sensors and engineering magnetism including FEM design and magnetic measurements and testing. The content of this advanced course can be modified according to the students´ needs.		
XP38PSL	Aircraft Instrumentation	ZK	4
	The subject acquaints students with the current technology used in aircraft with respect to instruments, systems and sensors working in the low-frequency field and with methods for basic processing of system data. The course includes a detailed description of aircraft instrumentation and its resistance to external influences, a description of aircraft power sources and power electrical engineering, analysis of instruments and systems for measurement of engine and aerometric quantities, and a description of emergency and operational diagnostics. It thus develops the background related to nowadays technology and methodology utilized on aircraft. The course provides a detailed overview of quantitative and qualitative research and analytical methods and their integration into signal/data processing and aircraft system design principles. The last part of the course discusses the current publishing activities in the field of aircraft instrumentation.		
XP38PUC		ZK	2
XP38SSA		ZK	3
	The course is focused on advanced sensors and data communication principles within heterogeneous automotive networks. It especially deals with modern wideband automotive sensors communication over the internal vehicle communication infrastructure.		
XP38SSB	Sensors and Buses	ZK	4
	The student will be introduced into the advanced topics of engineering sensors and sensor networks. Topics include: Sensor applications, physical principles, sensor types and important parameters, the concept of smart sensors, measurement systems, analog circuits for sensor signal processing, sensor error correction, calibration and diagnostics, noise and disturbance immunity.		
XP38SYS	Measurement and Data Acquisition Systems	ZK	4
	The subject introduces the principles and technical means of data acquisition in the laboratory and industrial environment. Attention is paid to both hardware and software aspects of the integration of systems for data acquisition and process control. Laboratory exercises are designed in part in the form of classical tasks, partly in the form of problem-oriented tasks in the field of programming of automated measurement systems and control of measurement processes.		

XP38VDI	Selected Chapters of Diagnostics	ZK	4
This course introduces advanced concepts of fault detection, isolation and diagnostics, signal analysis methods for machine condition monitoring, and principles and instrumentation of non-destructive testing, the corresponding advanced signal processing, and self-acting evaluation in order to improve reliability, availability, maintenance, and life-time.			
XP38VKP	Selected Parts of Instrumentation	ZK	4
The course is dedicated to principle, properties and applications of selected special measuring instruments. It deals mainly with calibrators and other sources of calibration signals, devices for measurement of extremely low voltage and current signals, lock-in amplifiers, power analyzers and electronic loads, devices used for EMC measurements, real-time spectrum analyzers, metallic and optical reflectometers and radio testers (Bluetooth, NMT, GSM, UMTS). A special part is devoted to sampling measurement methods and virtual instrumentation.			
XP38VKZ	Selected Chapters of Signal Processing	ZK	4
The course is dedicated to advanced signals processing methods used in contemporary electronic devices and measuring instruments. It concerns e.g. the other types of integral transformation (except Fourier), stochastic methods, processing of the multimedia signal, suppressing of unwanted effect, methods used for quality increasing of multimedia signal transmission, etc.			
XP39CG	Advanced Computational Geometry	ZK	4
The aim of the course is to deepen the knowledge of computational geometry. The course is designed primarily for students who have a dissertation topic related to data structures in computer graphics and effective work with them. The starting point of the study will be chapters from the compulsory literature, specific topics will be based on scientific articles that develop the issue. Students will have the latest articles on the subject and will creatively process the theme. This is mainly about mastering the methodology of scientific work taking into account the subject of the dissertation. Precisely this aspect (the methodology of scientific work in the given field) is one of the added values ofthe subject. The subject, with its theoretical character, invites directly to the above-defined concept.			
XP39PMV	Advanced Methods of Visualization	ZK	4
Scientific visualization based on physical models. Scientific visualization and volume rendering. Volume graphics. Information visualization. Interaction in scientific visualization environment. Scientific visualization in WWW environment. Particle models and visualization of technological processes. Computational fluid dynamics.			
XP39SCG	Seminar in Comnuter Graohics	ZK	4
The Seminar in Computer Graphics will make students familiar with selected research topics from computer graphics srrch aq efficienf renderino methndc mnrlelino nf srrrfacec qnd fheir nntical nronerties qimrrlafinn of nhvqical nhennmena or geometrical modeling and animation. The course rvill also include graphics methods used in related hiscipiines such as image processing, computer vision, and human computer interaction. The goal ofthe course is to expound the selected topics to students and in the same time to improve their scientific skills by analyzing existing high quality research rvork. A significant added value is the acquaintance of students with methods of scientific work in connection with the aim of using the gathered knowledge to solve specific problems of their PhD theses.			
XP39SPG	Computer Graphics Seminar	Z,ZK	4
The computer graphics seminar will cover selected research topics in computer graphics such as efficient rendering techniques, modeling of surface materials and their optical properties, simulation of natural phenomena, geometrical modeling and animation. In the seminar we will also discuss computer graphics techniques used in related research disciplines such as image processing, computer vision and human computer interaction based on the particular topics of PhD theses of the participating students. The goal of the course is to introduce the selected topics to the students and by analyzing selected highly influential research publications to further develop the research capabilities of the students.			
XP39UID	Advanced methods of UI design	ZK	4
The goal of the course is to introduce advanced methods for user interface and interaction design in non-standard environments, such as virtual and augmented reality. Students will gain theoretical background related to human interaction in such environments. During the course students will get familiar with a set of techniques for design and testing of interactive systems in non-standard environments, especially in virtual and augmented reality with collaborative aspects.			
XP39VIZ	Advanced Visualization Methods	ZK	4
Human factors in visualization (Perception and cognition, Visual saliency, Visual thinking) Design of User Interfaces for Visualization applications (Evaluation of visualization techniques) Advanced volume visualization (Illustrative volume rendering) Big data visualization, Visual analytics, Animation for visualization, Data compression and reduction Large scale data visualization Visualization techniques in nonstandard environment			
XP39VPG	Computational Geometry	ZK	4
Principles of computational geometry (CG), data structures and paradigms, methods of geometric search, convex polygons and hulls, applications of convex hull, proximity problems, Voronoi diagrams, triangulation, efficient intersection algorithms, intersection of semispaces and polygonal regions, geometry of rectangles, dual mappings and spaces, convex hull in dual space, algorithms of computer graphics and CG. Students who completed course 36VGE cannot enroll.			
XP39VR	Virtual reality	ZK	4
Advanced methods in the VRML language. Standard and non-standard extensions to the VRML language. Programming of external applications with EAI interface. Multi-user virtual reality. Distant cooperation in virtual environment. Hardware and software support for virtual reality systems. QuickTime VR. Specification X3D.			
XPE04SCWR	Scientific Writing	Z	4
1) LECTURES [Chang-Hee Won]: With the assistance of a Fulbright Distinguished Chair at CTU and a Professor in Electrical Engineering for Temple University (a research university located in Philadelpia, Pennsyvania, USA), researchers will be instructed on how to organize and effectively communicate their scientific results. While this instructor is an Electrical Engineer, the approaches will be applicable to all technical disciplines. 2) SEMINARS [Michael Ynsua]: Under the guidance of a native-speaking English teacher participants will focus on the fundamentals of academic writing with the goal of sharpening critical writing skills (reasoning, formulating, and developing arguments and explanations). Special attention will also be paid to mechanics, usage, and style (grammar, etc).			

For updated information see http://bilakniha.cvut.cz/en/f3.html
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