

Study plan

Name of study plan: Electronics and Integrated Systems

Faculty/Institute/Others: Faculty of Electrical Engineering

Department:

Branch of study guaranteed by the department: Welcome page

Garantor of the study branch:

Program of study: Electronics and Integrated Systems

Type of study: Follow-up master full-time

Required credits: 104

Elective courses credits: 16

Sum of credits in the plan: 120

Note on the plan:

Name of the block: Compulsory courses in the program

Minimal number of credits of the block: 68

The role of the block: P

Code of the group: 2026_MEISDIP

Name of the group: Diploma Thesis

Requirement credits in the group: In this group you have to gain 30 credits

Requirement courses in the group: In this group you have to complete 1 course

Credits in the group: 30

Note on the group:

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
BDIP30	Diploma Thesis	Z	30	22s	L	P

Characteristics of the courses of this group of Study Plan: Code=2026_MEISDIP Name=Diploma Thesis

BDIP30	Diploma Thesis				Z	30
Independent final comprehensive work for the Master's degree study programme. A student will choose a topic from a range of topics related to his or her branch of study, which will be specified by branch department or branch departments. The diploma thesis will be defended in front of the board of examiners for the comprehensive final examination.						

Code of the group: 2026_MEISP

Name of the group: Compulsory subjects of the programme

Requirement credits in the group: In this group you have to gain 38 credits

Requirement courses in the group: In this group you have to complete 7 courses

Credits in the group: 38

Note on the group:

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
B2M34EPL	Elektronika pevných látek Jan Voves	Z,ZK	6	3P+1C		P
B2M31IASA	Implementation of analog systems Jiří Hospodka, Ondřej Šubrt, Josef Dobeš, Jiří Náhlík Radoslav Bortel Radoslav Bortel (Gar.)	Z,ZK	6	2P+2C	Z	P
B2M34NAIO	Návrh analogových integrovaných obvodů Jiří Jakovenko	Z,ZK	6	2P+2C	Z	P
B2M34NDIO	Návrh digitálních integrovaných obvodů Vladimír Janiček	Z,ZK	6	2P+2C	L	P
B2M34NSV	VLSI System Design Pavel Hazdra, Jakub Jirsa Pavel Hazdra Pavel Hazdra (Gar.)	Z,ZK	6	2P+2L	L	P
B2MPROJ6	Project Jiří Jakovenko, Pavel Máša, Ivan Pravda, František Rund, Jan Šístek, Lubor Jirásek, Tomáš Zeman, Ladislav Oppl František Rund František Rund (Gar.)	Z	6	0p+6s	Z,L	P

B2M34PKO	Příprava k obhajobě <i>Vladimír Janiček</i>	Z	2	2P+2C	P
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Characteristics of the courses of this group of Study Plan: Code=2026_MEISP Name=Compulsory subjects of the programme

B2M34EPL	Elektronika pevných látek	Z,ZK	6
B2M311ASA	Implementation of analog systems The goal of the subject is to make students familiar with the new trends and concepts in analog circuits with an emphasis on the applications in the digital system peripherals. Here, the stress is placed on the design and implementation procedures of Application Specific Integrated Circuits (ASICs). Current design trends are discussed, including the analysis and test of analog and mixed signal circuits. The course provides knowledge for the development and design of electronic systems taking into account the aspects of current manufacturing technology of integrated circuits.	Z,ZK	6
B2M34NAIO	Návrh analogových integrovaných obvodů	Z,ZK	6
B2M34NDIO	Návrh digitálních integrovaných obvodů	Z,ZK	6
B2M34NSV	VLSI System Design Introduction to basic building blocks, architecture and design methodologies of advanced VLSI systems. Structure and design of digital and analogue integrated circuit subsystems. Integrated system description and synthesis using cell libraries and IP cores. Synchronization, power consumption and parasitics reduction issues. Testing and reliability of integrated systems. In seminars and labs, the hardware description language VHDL will be explained and used for practical design, synthesis and testing of a system on chip.	Z,ZK	6
B2MPROJ6	Project Independent work in the form of a project. A student will choose a topic from a range of topics related to his or her branch of study, which will be specified by branch department or branch departments. The project will be defended within the framework of a subject. Project list http://www.fel.cvut.cz/en/education/semestral-projects.html	Z	6
B2M34PKO	Příprava k obhajobě	Z	2

Name of the block: Compulsory elective courses

Minimal number of credits of the block: 36

The role of the block: PV

Code of the group: 2026_MEISPV

Name of the group: Compulsory subjects of the programme

Requirement credits in the group: In this group you have to gain at least 36 credits (at most 168)

Requirement courses in the group: In this group you have to complete at least 6 courses (at most 28)

Credits in the group: 36

Note on the group:

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) <i>Tutors, authors and guarantors (gar.)</i>	Completion	Credits	Scope	Semester	Role
B2M37AMP	Microprocessor Applications	Z,ZK	6	2P+2L	Z	PV
B4M38AVS	Embedded Systems Application <i>Jan Sobotka, Radek Sedláček Radek Sedláček Jan Fischer (Gar.)</i>	Z,ZK	6	2P+2L	L	PV
B2M37ART	Architecture of radio receivers and transmitters <i>Josef Dobeš, Pavel Kovář Karel Ulovec Pavel Kovář (Gar.)</i>	Z,ZK	6	2P+2L	L	PV
B3M38ASE	Automotive Sensors and Networks <i>Jan Sobotka, Antonín Platil, Jiří Novák Jiří Novák Jiří Novák (Gar.)</i>	Z,ZK	6	2P+2L	L	PV
ANI-BVSE	Embedded Security	Z,ZK	6	2P+2C	L	PV
B2M17CADA	CAD in HF Technique <i>Zbyněk Škvor Zbyněk Škvor Zbyněk Škvor (Gar.)</i>	Z,ZK	6	2P+2C	L	PV
BECM33DPL	Deep Learning Essentials <i>Lukáš Neumann Lukáš Neumann Karel Zimmermann (Gar.)</i>	Z,ZK	6	2P+2C	Z	PV
B2M13DMT	Diagnostické metody a testování v elektrotechnologii	Z,ZK	6	2P+2L	L	PV
B2M37EAK	Electroacoustics	Z,ZK	6	2P+2L	L	PV
B2M13MEL	Materials for Electrical Engineering	Z,ZK	6	2P+2L	Z	PV
B2M34MST	Microsystems <i>Michal Kóčí, Miroslav Husák, Adam Bouřa, Alexandr Laposa, Vojtěch Povolný Miroslav Husák Miroslav Husák (Gar.)</i>	Z,ZK	6	2P+2L	L	PV
B2M17MIMA	Microwave Measurements <i>Přemysl Hudec, Karel Hoffmann Viktor Adler Přemysl Hudec (Gar.)</i>	Z,ZK	6	2P+2L	L	PV
B2M17MIOA	Microwave Circuits <i>Přemysl Hudec, Karel Hoffmann Přemysl Hudec Milan Polívka (Gar.)</i>	Z,ZK	6	2P+2C	Z	PV
B2M34NANA	Nanoelectronics and Nanotechnology <i>Jan Voves Jan Voves Jan Voves (Gar.)</i>	Z,ZK	6	2P+2C	L	PV
B2M17NKA	Antennas Design and Technology <i>Milan Polívka, Pavel Hazdra, Milan Švanda Milan Švanda Milan Polívka (Gar.)</i>	Z,ZK	6	2P+2L	Z	PV
B2M34ZETA	Custom Electronics Design <i>Vít Záhlava Vít Záhlava Vít Záhlava (Gar.)</i>	KZ	6	2P+2L	Z	PV
B2M37OBFA	Image Photonics <i>Lukáš Krauz, Petr Páta Petr Páta Petr Páta (Gar.)</i>	Z,ZK	6	2P+2L	Z	PV
B2M34POF	Pokročilá optoelektronika a fotonika	Z,ZK	6	2P+2C		PV

B4M35PAP	Advanced Computer Architectures <i>Pavel Piša, Karel Kočí Pavel Piša Pavel Piša (Gar.)</i>	Z,ZK	6	2P+2C	Z	PV
B0M31DSP	Advanced DSP methods	Z,ZK	6	2P+2C	Z	PV
B2M34PNIS	Advanced Integrated System Design <i>Jiří Jakovenko, Dalibor Barri Dalibor Barri Jiří Jakovenko (Gar.)</i>	Z,ZK	6	2P+2C	Z	PV
B0M38PSR	Real -Time Systems Programming	Z,ZK	6	2P+2C	Z	PV
ANI-SIME	Digital Circuit Simulation and Verification <i>Martin Kohlík Martin Kohlík Martin Kohlík (Gar.)</i>	Z,ZK	6	2P+1C	Z	PV
B2M13SAJ	Reliability and Quality	Z,ZK	6	2P+2C	Z	PV
B2M34VKEA	Power Electronics <i>Pavel Hazdra, Vít Záhlava, Jan Novák Vít Záhlava Pavel Hazdra (Gar.)</i>	Z,ZK	6	2P+2L	L	PV
B2M13VET	Výroba elektronických sestav	Z,ZK	6	2P+2L	L	PV
BAM17EMC	Introduction to electromagnetic compatibility <i>Tomáš Kořínek Tomáš Kořínek Tomáš Kořínek (Gar.)</i>	Z,ZK	6	2P+2L	Z	PV
B2M31ZASA	Analog Signal Processing <i>Jiří Hospodka Jiří Hospodka Jiří Hospodka (Gar.)</i>	Z,ZK	6	2P+2L	L	PV

Characteristics of the courses of this group of Study Plan: Code=2026_MEISPV Name=Compulsory subjects of the programme

B2M37AMP	Microprocessor Applications	Z,ZK	6	The aim of the course is to familiarize students with the properties of microprocessor systems, teach them to effectively use the internal peripherals of the processor, connect external circuits to the processor bus, and create a moderately complex microprocessor system. Students will learn to write programs in the C language and possibly combine it with the symbolic address language.		
B4M38AVS	Embedded Systems Application	Z,ZK	6	This course presents applications of embedded systems and their specifics. It is expected that the students have had a programming course, and thus the course is more oriented on explaining and describing the blocks and functions of embedded systems and their use in signal processing, rather than writing code. After completing this course, students should have an overview of usability and power of available processors, and their peripherals, on the basis of which, they should be able to independently design embedded systems for a wide spectrum of applications.		
B2M37ART	Architecture of radio receivers and transmitters	Z,ZK	6	The subject deals with the architecture of the radio receivers and transmitters and software radio. The student s familiarize with the design and the modern methods of optimization of the radio receivers and transmitters' functional blocks and with the phenomena related with frequency conversion, noise sources and noise analyses. They learn conceptual radio receiver and transmitter design, including the level and frequency plans and their optimization. The course also deals with the digital signal processing blocks of the modern radio receivers and their practical implementation.		
B3M38ASE	Automotive Sensors and Networks	Z,ZK	6	The course provides students with a deeper insight into the functional principles of advanced sensor systems in cars, methods of signal processing in sensors and explains how to use them in vehicle subsystems. It also deals with distributed vehicle systems for real-time control and methods of their testing. Theoretical lectures are complemented by practical laboratory teaching with real elements (ECUs, sensors) of modern vehicles.		
ANI-BVSE	Embedded Security	Z,ZK	6	Students gain basic knowledge in selected topics of cryptography and cryptanalysis. The course focuses particularly on efficient implementations of cryptographic primitives in hardware and software (in embedded systems). Students gain a good overview of functionality of (hardware) cryptographic accelerators, smart cards, and resources for securing internal functions of computer systems.		
B2M17CADA	CAD in HF Technique	Z,ZK	6	Introduction into principles and techniques used in modern microwave circuit design.		
BECM33DPL	Deep Learning Essentials	Z,ZK	6	The course teaches deep learning methods on known robotic problems, such as semantic segmentation or reactive motion control. The overall goal is timeless, universal knowledge rather than listing all known deep learning architectures. Students are assumed to have working prior knowledge of mathematics (gradient, jacobian, hessian, gradient descent, Taylor polynomial) and machine learning (Bayes risk minimization, linear classifier). The labs are divided into two parts; in the first one, the students will solve elementary deep ML tasks from scratch (including the reimplementing of autograd backpropagation), and in the second one, students will build on existing templates in order to solve complex tasks including RL, vision transformers and generative networks. This course is part of inter-university program prg.ai Minor. This program includes the best of AI education in Prague with the goal to provide the students depper and broader view of arificial intelligence. More info on the program web https://prg.ai/minor .		
B2M13DMT	Diagnostické metody a testování v elektrotechnologii	Z,ZK	6	The course follows the needs of electrical production and research. It discussed diagnostic of materials and measurements of material properties, including measurement of important parameters of production and work environment. The subject also includes testing safe function of products and evaluating the obtained data.		
B2M37EAK	Electroacoustics	Z,ZK	6	The course introduces the principles of electroacoustic and electromechanical transducers from the perspective of physicas background and technological solutions. It also focuses on methods of analysis of transducers and electroacoustic systems. The main topics are acoustic transmitters (speakers, actuators) and acoustic receivers (microphones, sensors) and the principles of electroacoustic conversion used in them, as well as related electrical and acoustic systems (crossovers, baffles, waveguides) and, last but not least, measurement and calibration.		
B2M13MEL	Materials for Electrical Engineering	Z,ZK	6	At first a physical description of basic properties and basic types of materials for electrical engineering is carried out. Types of conductors, superconductors, insulators, magnetic materials and semiconductors, which are used in power electrical engineering, are presented. The stress is put on relationships between properties, technology and the use. The student will meet, in higher detail, with ceramics for electrical engineering, with properties of mica, glass and their applications, with environmental conductive joining, with materials for thin and thick films and with selected nanomaterials and their applications.		
B2M34MST	Microsystems	Z,ZK	6	The course deals with system integration applied in the design of digital and analog systems. It demonstrates the new possibilities of implementation and application of integrated microelectronic devices based on various physical and biochemical principles. It presents primarily MEMS technology that increases reliability with all its attributes. The course presents the modern action elements and microactuators, whose operation is based on fundamental physical and biochemical principles, including basic applications in micromanipulation, microrobots, microdrives, microsurgery, multimedia, medical, industrial control, automotive, etc. In the course are presented the principles of touch screens, microgenerators of electrical energy. There are mentioned basic elements of the use of nanotechnology and nanoelectronic structures and basic microsystem technologies.		

B2M17MIMA	Microwave Measurements	Z,ZK	6
Fast development of wireless radio data communications (both mobile and stationary) also results in requirements for measurement of numerous related electrical parameters in frequency band ranging from hundreds of MHz to tens of GHz. The "Microwave measurements" subject brings description of all important measurement instruments and measurement methods used in this field. Instructions devoted to measurement devices also cover detailed inner structures, principles of operation, common measurement setups and optimum setting. Even relatively complex measurement instruments and setups are discussed, for example those used for measurement of noise and non-linear parameters. Exercises are focused on practical measurements commonly performed in the wireless communication field. Besides modern measurement instruments, students also learn a number of typical RF and microwave components, circuits, subsystems and digitally modulated signals.			
B2M17MIOA	Microwave Circuits	Z,ZK	6
Subject is focused on the design of planar passive and active microwave circuits.			
B2M34NANA	Nanoelectronics and Nanotechnology	Z,ZK	6
The subject is oriented on the present nanotechnologies in the connection with their electronic, photonic and spintronic applications. Quantum theory basics are used to explain the effects observed in nanostructures. Basic nanoelectronic structures are described with their possible applications. Modern computer methods and models, which are able to simulate the operation of nanoelectronic structures and which are the important tools for their design and optimisation, are studied.			
B2M17NKA	Antennas Design and Technology	Z,ZK	6
Basics of practical antenna design for selected frequency bands and communication, identification and radar services. Modelling (full-wave analysis), design relationships and specifics of antenna construction using professional software tools. Design and manufacture of antenna sample. Practical measurements.			
B2M34ZETA	Custom Electronics Design	KZ	6
The course deals with the design methodology of advanced custom electronics. The aim is to convert theoretical knowledge of previous studies into specific proposals for practical applications. Student are getting familiar with the problems encountered in the professional electronic design and manufacturing. This course is based on real experience in development and production, showing the latest technological trends and component base.			
B2M37OBFA	Image Photonics	Z,ZK	6
The subject offers a detailed overview of applied imaging photonic elements and systems. The subject deals with fundamentals of optics, Fourier optics and optical computing. Fourier optics. Image sensors - tube, CCD, CMOS. Image displays. Image converters and amplifiers. Photography and holography - sensitometry and densitometry. Photonic (optical) computing. Electron optics. Image processing in biosystems. Image processing for photonics.			
B2M34POF	Pokročilá optoelektronika a fotonika	Z,ZK	6
B4M35PAP	Advanced Computer Architectures	Z,ZK	6
B0M31DSP	Advanced DSP methods	Z,ZK	6
The course introduces advanced methods of analysis and processing of digital signals such as correlation, spectral, coherence or cepstral analysis, as well as methods of decomposition into principal and independent components, methods for determining the relationship between random signals and basic classification techniques used in signal analysis. Attention is paid to practical applications of the mentioned techniques, e.g. for noise suppression or compression.			
B2M34PNIS	Advanced Integrated System Design	Z,ZK	6
The course focuses on the complex process of integrated circuit design from theoretical foundations to practical physical implementations (layouts). The lectures gradually discuss the principles of chip design, the differences between discrete and integrated technologies, CMOS and BCD technologies, the methodology for the correct design of transistors and circuit structures, advanced approaches to power MOS transistors and building blocks (reference circuits, dividers, mixed-signal elements, stability). Other parts are devoted to the design of linear voltage regulators (LDO), protections (OCP, eFuse, ESD), issues of parasitic phenomena, chip topologies and physical design methods including automation and programming in Python. The course also covers issues of testing, error diagnostics and economic aspects of chip production. Exercises provide practical experience with the Cadence Virtuoso design environment and the SKILL language. The course covers the complete design of an integrated LDO regulator with current protection, including a detailed design of a power transistor and a feedback resistor divider. They also focus on advanced current mirrors, circuit stability solutions and the gradual addition of protection mechanisms. Within the framework of physical design, the creation of power structures of MOSFETs, paired elements and programmable resistor dividers is practiced, followed by verification (DRC, LVS). The course is concluded with practical exercises focused on the automation of analog design of integrated circuits.			
B0M38PSR	Real -Time Systems Programming	Z,ZK	6
The goal of this course is to provide students with basic knowledge about software development for real-time systems, for example in control and embedded applications. The focus is on embedded systems equipped with a real-time operating system (RTOS). Lectures will cover real-time systems theory, which can be used to formally verify timing correctness of such systems. Another set of lectures will introduce methods and techniques used for development of safety-critical systems, whose failure may have catastrophic consequences. During labs, students will first solve a few simple tasks to familiarize themselves with basic components of VxWorks RTOS and to benchmark the used OS and hardware (Xilinx Zynq). The obtained metrics represent the typical criteria for assessing the suitability of a given platform for the given application. After the simple tasks, students will solve a complex task of time-critical motion control application which will require full utilization of RTOS features. All the tasks at the labs will be implemented in C (or C++) language.			
ANI-SIME	Digital Circuit Simulation and Verification	Z,ZK	6
The aim of the course is to acquaint the students with principles of digital circuit simulation at RTL (Register Transfer Level) and TLM (Transaction Level Modeling) levels and with the properties of proper tools. The course covers recent verification methods, too.			
B2M13SAJ	Reliability and Quality	Z,ZK	6
Terminology and definitions from the area of quality and reliability and their control, philosophy of quality, systems of quality control in the world. Reliability as a part of quality. Basic definitions from the area of reliability, basic distributions used in reliability and their basic characteristics. Back-up using a warm and cold standby, types of warm and cold standbys. Reliability of components and systems, calculation of reliability using composition and decomposition. and using a method of a list. Basic statistical methods and tools joined with quality control, managerial tools for quality control. Techniques FMEA and QFFD, house of quality. Capability of a process. Taguchi loss function. Audits. Statistical inspection.			
B2M34VKEA	Power Electronics	Z,ZK	6
The course introduces into the problematic of power electronics. First part of lectures deals with principles and structures of contemporary semiconductor power devices. The impact of novel semiconductor materials is discussed, as well. Circuit models of particular devices will be then explained, driving circuits, switching of the resistive, inductive and capacitive loads, power losses and device operation reliability will be thoroughly discussed. Second part of lectures is dedicated to the problematic of power converters, their topologies, control techniques and circuits. Electromagnetic compatibility and PCB design for power converters will be discussed, as well.			
B2M13VET	Výroba elektronických sestav	Z,ZK	6
(obsolete text, currently valid is czech version) Mechanical and electrical design. The electric contact. Joining of conductors. Cooling of components and equipment. Printed circuit boards fabrication. Soldering in electronics. Electromagnetic compatibility of electronic equipment. Protection of components and equipment sensitive on electrostatic field. Certification, accreditation, quality control and quality assurance.			
BAM17EMC	Introduction to electromagnetic compatibility	Z,ZK	6
The subject dwells on problems of electromagnetic compatibility. Students obtain the basic knowledges in the field of electromagnetic compatibility - electromagnetic interference, susceptibility and testing methods. The subject leads to gain professional skills in the field of electrical engineering.			
B2M31ZASA	Analog Signal Processing	Z,ZK	6
The course deals with analog input-output blocks for signal transmission and processing. They discussed circuit solution of amplifiers and filters, including their design process, simulation and measurement. Students learn the circuit concepts and possibilities for solving the contemporary analogue structures. The second part of the course describes the design and implementation of analog filters, including discrete-time circuits. The conclusion is devoted to the possibilities of computer optimization of electronic circuits and filters.			

Name of the block: Elective courses

Minimal number of credits of the block: 0

The role of the block: V

Code of the group: 2026_MEISVOL

Name of the group: Elective subjects

Requirement credits in the group:

Requirement courses in the group:

Credits in the group: 0

Note on the group:

~Nabídku volitelných předmětů uspořádaných podle kateder najdete na webových stránkách <http://www.fel.cvut.cz/cz/education/volitelne-predmety.html>

List of courses of this pass:

Code	Name of the course	Completion	Credits
ANI-BVSE	Embedded Security	Z,ZK	6
Students gain basic knowledge in selected topics of cryptography and cryptanalysis. The course focuses particularly on efficient implementations of cryptographic primitives in hardware and software (in embedded systems). Students gain a good overview of functionality of (hardware) cryptographic accelerators, smart cards, and resources for securing internal functions of computer systems.			
ANI-SIME	Digital Circuit Simulation and Verification	Z,ZK	6
The aim of the course is to acquaint the students with principles of digital circuit simulation at RTL (Register Transfer Level) and TLM (Transaction Level Modeling) levels and with the properties of proper tools. The course covers recent verification methods, too.			
B0M31DSP	Advanced DSP methods	Z,ZK	6
The course introduces advanced methods of analysis and processing of digital signals such as correlation, spectral, coherence or cepstral analysis, as well as methods of decomposition into principal and independent components, methods for determining the relationship between random signals and basic classification techniques used in signal analysis. Attention is paid to practical applications of the mentioned techniques, e.g. for noise suppression or compression.			
B0M38PSR	Real -Time Systems Programming	Z,ZK	6
The goal of this course is to provide students with basic knowledge about software development for real-time systems, for example in control and embedded applications. The focus is on embedded systems equipped with a real-time operating system (RTOS). Lectures will cover real-time systems theory, which can be used to formally verify timing correctness of such systems. Another set of lectures will introduce methods and techniques used for development of safety-critical systems, whose failure may have catastrophic consequences. During labs, students will first solve a few simple tasks to familiarize themselves with basic components of VxWorks RTOS and to benchmark the used OS and hardware (Xilinx Zynq). The obtained metrics represent the typical criteria for assessing the suitability of a given platform for the given application. After the simple tasks, students will solve a complex task of time-critical motion control application which will require full utilization of RTOS features. All the tasks at the labs will be implemented in C (or C++) language.			
B2M13DMT	Diagnostické metody a testování v elektrotechnologii	Z,ZK	6
The course follows the needs of electrical production and research. It discussed diagnostic of materials and measurements of material properties, including measurement of important parameters of production and work environment. The subject also includes testing safe function of products and evaluating the obtained data.			
B2M13MEL	Materials for Electrical Engineering	Z,ZK	6
At first a physical description of basic properties and basic types of materials for electrical engineering is carried out. Types of conductors, superconductors, insulators, magnetic materials and semiconductors, which are used in power electrical engineering, are presented. The stress is put on relationships between properties, technology and the use. The student will meet, in higher detail, with ceramics for electrical engineering, with properties of mica, glass and their applications, with environmental conductive joining, with materials for thin and thick films and with selected nanomaterials and their applications.			
B2M13SAJ	Reliability and Quality	Z,ZK	6
Terminology and definitions from the area of quality and reliability and their control, philosophy of quality, systems of quality control in the world. Reliability as a part of quality. Basic definitions from the area of reliability, basic distributions used in reliability and their basic characteristics. Back-up using a warm and cold standby, types of warm and cold standbys. Reliability of components and systems, calculation of reliability using composition and decomposition. and using a method of a list. Basic statistical methods and tools joined with quality control, managerial tools for quality control. Techniques FMEA and QFFD, house of quality. Capability of a process. Taguchi loss function. Audits. Statistical inspection.			
B2M13VET	Výroba elektronických sestav	Z,ZK	6
(obsolete text, currently valid is czech version) Mechanical and electrical design. The electric contact. Joining of components. Cooling of components and equipment. Printed circuit boards fabrication. Soldering in electronics. Electromagnetic compatibility of electronic equipment. Protection of components and equipment sensitive on electrostatic field. Certification, accreditation, quality control and quality assurance.			
B2M17CADA	CAD in HF Technique	Z,ZK	6
Introduction into principles and techniques used in modern microwave circuit design.			
B2M17MIMA	Microwave Measurements	Z,ZK	6
Fast development of wireless radio data communications (both mobile and stationary) also results in requirements for measurement of numerous related electrical parameters in frequency band ranging from hundreds of MHz to tens of GHz. The "Microwave measurements" subject brings description of all important measurement instruments and measurement methods used in this field. Instructions devoted to measurement devices also cover detailed inner structures, principles of operation, common measurement setups and optimum setting. Even relatively complex measurement instruments and setups are discussed, for example those used for measurement of noise and non-linear parameters. Exercises are focused on practical measurements commonly performed in the wireless communication field. Besides modern measurement instruments, students also learn a number of typical RF and microwave components, circuits, subsystems and digitally modulated signals.			
B2M17MIOA	Microwave Circuits	Z,ZK	6
Subject is focused on the design of planar passive and active microwave circuits.			
B2M17NKA	Antennas Design and Technology	Z,ZK	6
Basics of practical antenna design for selected frequency bands and communication, identification and radar services. Modelling (full-wave analysis), design relationships and specifics of antenna construction using professional software tools. Design and manufacture of antenna sample. Practical measurements.			

B2M31IASA	Implementation of analog systems	Z,ZK	6
The goal of the subject is to make students familiar with the new trends and concepts in analog circuits with an emphasis on the applications in the digital system peripherals. Here, the stress is placed on the design and implementation procedures of Application Specific Integrated Circuits (ASICs). Current design trends are discussed, including the analysis and test of analog and mixed signal circuits. The course provides knowledge for the development and design of electronic systems taking into account the aspects of current manufacturing technology of integrated circuits.			
B2M31ZASA	Analog Signal Processing	Z,ZK	6
The course deals with analog input-output blocks for signal transmission and processing. They discussed circuit solution of amplifiers and filters, including their design process, simulation and measurement. Students learn the circuit concepts and possibilities for solving the contemporary analogue structures. The second part of the course describes the design and implementation of analog filters, including discrete-time circuits. The conclusion is devoted to the possibilities of computer optimization of electronic circuits and filters.			
B2M34EPL	Elektronika pevných látek	Z,ZK	6
B2M34MST	Microsystems	Z,ZK	6
The course deals with system integration applied in the design of digital and analog systems. It demonstrates the new possibilities of implementation and application of integrated microelectronic devices based on various physical and biochemical principles. It presents primarily MEMS technology that increases reliability with all its attributes. The course presents the modern action elements and microactuators, whose operation is based on fundamental physical and biochemical principles, including basic applications in micromanipulation, microrobots, microdrives, microsurgery, multimedia, medical, industrial control, automotive, etc. In the course are presented the principles of touch screens, microgenerators of electrical energy. There are mentioned basic elements of the use of nanotechnology and nanoelectronic structures and basic microsystem technologies.			
B2M34NAIO	Návrh analogových integrovaných obvodů	Z,ZK	6
B2M34NANA	Nanoelectronics and Nanotechnology	Z,ZK	6
The subject is oriented on the present nanotechnologies in the connection with their electronic, photonic and spintronic applications. Quantum theory basics are used to explain the effects observed in nanostructures. Basic nanoelectronic structures are described with their possible applications. Modern computer methods and models, which are able to simulate the operation of nanoelectronic structures and which are the important tools for their design and optimisation, are studied.			
B2M34NDIO	Návrh digitálních integrovaných obvodů	Z,ZK	6
B2M34NSV	VLSI System Design	Z,ZK	6
Introduction to basic building blocks, architecture and design methodologies of advanced VLSI systems. Structure and design of digital and analogue integrated circuit subsystems. Integrated system description and synthesis using cell libraries and IP cores. Synchronization, power consumption and parasitics reduction issues. Testing and reliability of integrated systems. In seminars and labs, the hardware description language VHDL will be explained and used for practical design, synthesis and testing of a system on chip.			
B2M34PKO	Příprava k obhajobě	Z	2
B2M34PNIS	Advanced Integrated System Design	Z,ZK	6
The course focuses on the complex process of integrated circuit design from theoretical foundations to practical physical implementations (layouts). The lectures gradually discuss the principles of chip design, the differences between discrete and integrated technologies, CMOS and BCD technologies, the methodology for the correct design of transistors and circuit structures, advanced approaches to power MOS transistors and building blocks (reference circuits, dividers, mixed-signal elements, stability). Other parts are devoted to the design of linear voltage regulators (LDO), protections (OCP, eFuse, ESD), issues of parasitic phenomena, chip topologies and physical design methods including automation and programming in Python. The course also covers issues of testing, error diagnostics and economic aspects of chip production. Exercises provide practical experience with the Cadence Virtuoso design environment and the SKILL language. The course covers the complete design of an integrated LDO regulator with current protection, including a detailed design of a power transistor and a feedback resistor divider. They also focus on advanced current mirrors, circuit stability solutions and the gradual addition of protection mechanisms. Within the framework of physical design, the creation of power structures of MOSFETs, paired elements and programmable resistor dividers is practiced, followed by verification (DRC, LVS). The course is concluded with practical exercises focused on the automation of analog design of integrated circuits.			
B2M34POF	Pokročilá optoelektronika a fotonika	Z,ZK	6
B2M34VKEA	Power Electronics	Z,ZK	6
The course introduces into the problematic of power electronics. First part of lectures deals with principles and structures of contemporary semiconductor power devices. The impact of novel semiconductor materials is discussed, as well. Circuit models of particular devices will be then explained, driving circuits, switching of the resistive, inductive and capacitive loads, power losses and device operation reliability will be thoroughly discussed. Second part of lectures is dedicated to the problematic of power converters, their topologies, control techniques and circuits. Electromagnetic compatibility and PCB design for power converters will be discussed, as well.			
B2M34ZETA	Custom Electronics Design	KZ	6
The course deals with the design methodology of advanced custom electronics. The aim is to convert theoretical knowledge of previous studies into specific proposals for practical applications. Student are getting familiar with the problems encountered in the professional electronic design and manufacturing. This course is based on real experience in development and production, showing the latest technological trends and component base.			
B2M37AMP	Microprocessor Applications	Z,ZK	6
The aim of the course is to familiarize students with the properties of microprocessor systems, teach them to effectively use the internal peripherals of the processor, connect external circuits to the processor bus, and create a moderately complex microprocessor system. Students will learn to write programs in the C language and possibly combine it with the symbolic address language.			
B2M37ART	Architecture of radio receivers and transmitters	Z,ZK	6
The subject deals with the architecture of the radio receivers and transmitters and software radio. The student s familiarize with the design and the modern methods of optimization of the radio receivers and transmitters' functional blocks and with the phenomena related with frequency conversion, noise sources and noise analyses. They learn conceptual radio receiver and transmitter design, including the level and frequency plans and their optimization. The course also deals with the digital signal processing blocks of the modern radio receivers and their practical implementation.			
B2M37EAK	Electroacoustics	Z,ZK	6
The course introduces the principles of electroacoustic and electromechanical transducers from the perspective of physics background and technological solutions. It also focuses on methods of analysis of transducers and electroacoustic systems. The main topics are acoustic transmitters (speakers, actuators) and acoustic receivers (microphones, sensors) and the principles of electroacoustic conversion used in them, as well as related electrical and acoustic systems (crossovers, baffles, waveguides) and, last but not least, measurement and calibration.			
B2M37OBFA	Image Photonics	Z,ZK	6
The subject offers a detailed overview of applied imaging photonic elements and systems. The subject deals with fundamentals of optics, Fourier optics and optical computing. Fourier optics. Image sensors - tube, CCD, CMOS. Image displays. Image converters and amplifiers. Photography and holography - sensitometry and densitometry. Photonic (optical) computing. Electron optics. Image processing in biosystems. Image processing for photonics.			
B2MPROJ6	Project	Z	6
Independent work in the form of a project. A student will choose a topic from a range of topics related to his or her branch of study, which will be specified by branch department or branch departments. The project will be defended within the framework of a subject. Project list http://www.fel.cvut.cz/en/education/semestral-projects.html			
B3M38ASE	Automotive Sensors and Networks	Z,ZK	6
The course provides students with a deeper insight into the functional principles of advanced sensor systems in cars, methods of signal processing in sensors and explains how to use them in vehicle subsystems. It also deals with distributed vehicle systems for real-time control and methods of their testing. Theoretical lectures are complemented by practical laboratory teaching with real elements (ECUs, sensors) of modern vehicles.			

B4M35PAP	Advanced Computer Architectures	Z,ZK	6
B4M38AVS	Embedded Systems Application	Z,ZK	6
This course presents applications of embedded systems and their specifics. It is expected that the students have had a programming course, and thus the course is more oriented on explaining and describing the blocks and functions of embedded systems and their use in signal processing, rather than writing code. After completing this course, students should have an overview of usability and power of available processors, and their peripherals, on the basis of which, they should be able to independently design embedded systems for a wide spectrum of applications.			
BAM17EMC	Introduction to electromagnetic compatibility	Z,ZK	6
The subject dwells on problems of electromagnetic compatibility. Students obtain the basic knowledges in the field of electromagnetic compatibility - electromagnetic interference, susceptibility and testing methods. The subject leads to gain professional skills in the field of electrical engineering.			
BDIP30	Diploma Thesis	Z	30
Independent final comprehensive work for the Master's degree study programme. A student will choose a topic from a range of topics related to his or her branch of study, which will be specified by branch department or branch departments. The diploma thesis will be defended in front of the board of examiners for the comprehensive final examination.			
BECM33DPL	Deep Learning Essentials	Z,ZK	6
The course teaches deep learning methods on known robotic problems, such as semantic segmentation or reactive motion control. The overall goal is timeless, universal knowledge rather than listing all known deep learning architectures. Students are assumed to have working prior knowledge of mathematics (gradient, jacobian, hessian, gradient descent, Taylor polynomial) and machine learning (Bayes risk minimization, linear classifier). The labs are divided into two parts; in the first one, the students will solve elementary deep ML tasks from scratch (including the reimplementation of autograd backpropagation), and in the second one, students will build on existing templates in order to solve complex tasks including RL, vision transformers and generative networks. This course is part of inter-university program prg.ai Minor. This program includes the best of AI education in Prague with the goal to provide the students deeper and broader view of artificial intelligence. More info on the program web https://prg.ai/minor .			

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

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