Study plan

Name of study plan: Electronics and Communications - Technology of the Internet of Things

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 Communications
Type of study: Follow-up master full-time
Required credits: 109
Elective courses credits: 11
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: 79
The role of the block: P

Code of the group: 2018_MEKDIP
Name of the group: Diploma Thesis
Requirement credits in the group: In this group you have to gain 25 credits
Requirement courses in the group: In this group you have to complete 1 course
Credits in the group: 25
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
BDIP25	**Diploma Thesis**	Z	25	22s	L	P

Characteristics of the courses of this group of Study Plan: Code=2018_MEKDIP Name=Diploma Thesis

BDIP25	Diploma Thesis	Z	25

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: 2018_MEKP4
Name of the group: Compulsory subjects of the programme
Requirement credits in the group: In this group you have to gain 54 credits
Requirement courses in the group: In this group you have to complete 9 courses
Credits in the group: 54
Note on the group: Specializace technologie internetu věcí

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
B2M32BTSA	**Wireless Technologies** *Zdeněk Bečvář, Lukáš Vojtěch, Zbyněk Kocur, Pavel Mach **Ján Kučerák** Zdeněk Bečvář (Gar.)*	Z,ZK	6	2P + 2L	L	P
B2M37MAM	**Microprocessors** *Petr Skalický, Stanislav Vítek **Stanislav Vítek** Stanislav Vítek (Gar.)*	Z,ZK	6	2P+2L	Z	P
B2M34MST	**Microsystems** *Michal Kočí, Miroslav Husák, Adam Bouřa, Alexandr Laposa **Miroslav Husák** Miroslav Husák (Gar.)*	Z,ZK	6	2P+2L	L	P
B2M32MKSA	**Mobile Networks** *Zdeněk Bečvář, Pavel Mach, Robert Bešťák **Pavel Mach** Zdeněk Bečvář (Gar.)*	Z,ZK	6	2P + 2L	Z	P
B2M31DSP	**Advanced DSP methods** *Pavel Sovka, Petr Pollák **Pavel Sovka** Pavel Sovka (Gar.)*	Z,ZK	6	2P+2C	Z,L	P

B2M32PST	**Advanced Networking Technologies** *Zbyněk Kocur, Leoš Boháč* ***Leoš Boháč*** *Leoš Boháč (Gar.)*	Z,ZK	6	2P + 2C + 4D	Z	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
B2M34SIS	**Integrated System Structures** *Jiří Jakovenko, Vladimír Janíček* ***Vladimír Janíček*** *Jiří Jakovenko (Gar.)*	Z,ZK	6	2P+2C	Z	P
B2M17SBS	**Wave Propagation for Wireless Links** *Pavel Pechač* ***Pavel Pechač*** *Pavel Pechač (Gar.)*	Z,ZK	6	2P+2C	L	P

Characteristics of the courses of this group of Study Plan: Code=2018_MEKP4 Name=Compulsory subjects of the programme

B2M32BTSA	Wireless Technologies	Z,ZK	6

The lectures give overview of fundamental principles of wireless networks in various areas of their application. Students will understand architecture, principles and protocols used in different wireless technologies and learn how these technologies can be exploited in real world applications. The goal is to teach students how to solve problems related to deployment of wireless networks, their operation or development of wireless networks components.

B2M37MAM	Microprocessors	Z,ZK	6

The aim is to make students acquainted with the properties of microprocessor systems, make students familiar with on-chip peripherals, connect external circuit to the processor bus, and with implementation of the memory or I/O space address extension. Next, taught the students to make simple program in the assembly language, C language and combination of both. After completion of this subject student should be able to design and implement simpler microprocessor system including connection of necessary peripherals and software design.

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.

B2M32MKSA	Mobile Networks	Z,ZK	6

The lectures introduce principles and functionalities of mobile networks with special focus on currently deployed technologies and future mobile networks. Furthermore, architecture and fundamental principles of GSM, UMTS, LTE/LTE-A, and 5G will be explained. Then, selected key technologies for future mobile networks (6G) will be explained.

B2M31DSP	Advanced DSP methods	Z,ZK	6

The course follows the basic course in signal processing and introduces advanced methods of analysis and digital signal processing. Graduates will learn the methods of digital signals analysis and be able to practically use them. They learn to know the conditions of use of correlation, spectral and coherent analysis of random signals. They will became familiar with methods of signal decomposition and independent component analysis and the time-frequency transformations. Emphasis will be placed on an ability to interpret the results of signal analyses.

B2M32PST	Advanced Networking Technologies	Z,ZK	6

Subject Advanced Network Technologies expands students' knowledge of modern network technologies. The course is practically oriented and focused on explaining the function of advanced network protocols as used in modern data networks of today and tomorrow. Students will gain practical experience with the issues like Internet routing, software-defined networks, multicast routing, IPv6, and MPLS networks. Part of the course is also devoted to a detailed explanation of transport protocols TCP/UDP and a manner in which software applications can access transportation services of TCP/IP data networks.

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

B2M34SIS	Integrated System Structures	Z,ZK	6

Student learn main design methodologies of analog, digital and optoelectronic integrated systems; Detailed description of the technological process for the IC production; CMOS technologies and its advanced sub-micron trends; IC chip topology, layout and design rules; Technology of micro-electro-mechanical systems MEMS.

B2M17SBS	Wave Propagation for Wireless Links	Z,ZK	6

The aim of the course is to study the wireless transmission channel in real environments focusing on wave propagation for planning of terrestrial and satellite wireless links. The syllabus includes both deeper theoretical foundations of radio wave propagation in the atmosphere as well as ITU-R design procedures for terrestrial and satellite, fixed and mobile communications in various frequency bands.

Name of the block: Compulsory elective courses
Minimal number of credits of the block: 30
The role of the block: PV

Code of the group: 2018_MEKPV4
Name of the group: Compulsory subjects of the programme
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 5 courses
Credits in the group: 30
Note on the group: Specializace technologie internetu věcí

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**
B2M31ADAA	**Adaptive signal processing** *Pavel Sovka, Radoslav Bortel* ***Radoslav Bortel*** *Radoslav Bortel (Gar.)*	Z,ZK	6	2P+2C	Z	PV
B2M31AEDA	**Experimental Data Analysis** *Jan Rusz* ***Jan Rusz*** *Jan Rusz (Gar.)*	Z,ZK	6	2P+2C	Z	PV

B2M17ANT	**Antennas** *Pavel Hazdra, Miloš Mazánek, Jan Kraček **Jan Kraček** Pavel Hazdra (Gar.)*	Z,ZK	6	2P+2L	L	PV
B2M37ART	**Architecture of radio receivers and transmitters** *Josef Dobeš, Pavel Kovář **Karel Ulovec** Pavel Kovář (Gar.)*	Z,ZK	6	2P+2L	Z	PV
B2M32DSAA	**Network Application Diagnostics** *Radek Mařík **Radek Mařík** Radek Mařík (Gar.)*	Z,ZK	6	2P + 2C	Z	PV
B2M37DKM	**Digital communications** *Jan Sýkora **Jan Sýkora** Jan Sýkora (Gar.)*	Z,ZK	6	3P+1C	Z	PV
B2M32IBEA	**Information Security** *Tomáš Vaněk **Petr Hampl** Leoš Boháč (Gar.)*	Z,ZK	6	2P + 2C	L	PV
B2M37KDKA	**Coding in digital communications** *Jan Sýkora **Jan Sýkora** Jan Sýkora (Gar.)*	Z,ZK	6	3P+1C	L	PV
B2M34NIS	**Design of Integrated Circuits** *Jiří Jakovenko, Jan Novák **Jan Novák** Jiří Jakovenko (Gar.)*	Z,ZK	6	2P+2C	L	PV
B2M34NSV	**VLSI System Design** *Pavel Hazdra, Jakub Jirsa **Pavel Hazdra** Pavel Hazdra (Gar.)*	Z,ZK	6	2P+2L	Z	PV
B2M34ZETA	**Custom Electronics Design** *Vít Záhlava **Vít Záhlava** Vít Záhlava (Gar.)*	KZ	6	2P+2L	Z	PV
B2M37OBFA	**Image Photonics** *Lukáš Krauz, Petr Páta **Petr Páta** Petr Páta (Gar.)*	Z,ZK	6	2P+2L	Z	PV
B3M35PSR	**Real -Time Systems Programming** *Michal Sojka **Michal Sojka** Michal Sojka (Gar.)*	Z,ZK	6	2P+2C	Z	PV

Characteristics of the courses of this group of Study Plan: Code=2018_MEKPV4 Name=Compulsory subjects of the programme

B2M31ADAA	Adaptive signal processing	Z,ZK	6

This course provides a basic discourse on adaptive algorithms for filtering, decorrelation, separation and beamforming.

B2M31AEDA	Experimental Data Analysis	Z,ZK	6

In the course of subject "Experimental Data Analysis", students will acquire knowledge regarding fundamental methods for data analysis and machine learning for evaluation and interpretation of data. In the course of practical lectures, students will solve individual tasks using real data from signal processing in neuroscience research. In the course of semestral project, student will solve complex task and present obtained results. The aim of the subject is to introduce practical application of fundamental statistical methods as well as to teach students to use critical thinking and to acquire additional knowledge in solution of practical tasks.

B2M17ANT	Antennas	Z,ZK	6

Student will get strong knowledge about theory of electromagnetic field radiation and basic principles of antenna design. Methods of analysis are demonstrated on various types of antennas and their arrays. Seminars are both theoretical (analytical and numerical calculation using MATLAB and EM simulators CST) and practical (measurement of antenna parameters).

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.

B2M32DSAA	Network Application Diagnostics	Z,ZK	6

The first part of the course deals with complex network structures, their characteristics identification, with recognition of both structural static and dynamic patterns, and anomaly detection. The second part of the course is focused on specification methods of static and dynamic behavior and their verification. The use of the methods is demonstrated on examples dealing with network application issues. The special treatment is dedicated not only to network and cloud applications, but also to posibilities of diagnostic process automation. The students gain sufficient skills in seminars where they solve practical problems in digital network domain.

B2M37DKM	Digital communications	Z,ZK	6

The course provides fundamentals of digital communications theory: modulation, classical coding, channel models, and basic principles of decoding. The exposition is systematically built along the theoretical lines which allow to reveal all inner connections and principles. This allows students to develop the knowledge and use it in an active way in a design and construction of the communication systems. The course provides a necessary fundamental background for subsequent more advanced communications theory courses.

B2M32IBEA	Information Security	Z,ZK	6

The Information Security course provides a complete source of information on the field of security of information systems and information technologies. The most of information in today society is created, transferred, stored in electronic form so information security is very important part of it. Technical background for information security is provided by cryptology.

B2M37KDKA	Coding in digital communications	Z,ZK	6

This course extends and deepens the topics of the basic communication theory courses in the following main areas. 1) Advanced information theory in coding and Network Information Theory develop a framework for understanding the principles of the channel coding in single-user and multi-node/multi-user scenarios. 2) The algebraic coding presents classical topics of block and convolutional codes. 3) Advanced coding technique focuses on turbo, LDPC, Space-Time codes and Wireless Network Coding. 4) Advanced decoding technique, namely iterative and multi-user decoding is a fundamental tool for decoding capacity approaching channel codes.

B2M34NIS	Design of Integrated Circuits	Z,ZK	6

Main tasks of integrated circuits designer; design abstraction levels - Y chart. Definitions of specification, feasibility study, criteria for technology and design kits selection. Integrated systems design and simulation methodologies. Main features of full custom design, gate array, standard cells, programmable array logic. Design aspects of RF and mobile low power systems. Verilog-A, Verilog-AMS, VHDL-A. Logic and physical synthesis. Frond End and Back End design. Floorplanning, place and route, layout, parasitic extraction, time analysis, testbenches design and verification.

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.

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.

B3M35PSR	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.

Name of the block: Elective courses
Minimal number of credits of the block: 0
The role of the block: V

Code of the group: 2018_MEKH
Name of the group: Humanities subjects
Requirement credits in the group:
Requirement courses in the group:
Credits in the group: 0
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
B0M16FIL	*Peter Zamarovský* ***Peter Zamarovský*** *Peter Zamarovský (Gar.)*	Z,ZK	5	2P+2S	Z,L	v
B0M16HVT	**History of science and technology 2** *Marcela Efmertová, Jan Mikeš* ***Marcela Efmertová*** *Marcela Efmertová (Gar.)*	Z,ZK	5	2P+2S	Z,L	v
B0M16HSD1	**History of economy and social studies** ***Marcela Efmertová***	Z,ZK	5	2P+2S	Z,L	v
B0M16PSM	**Psychology** *Jan Fiala* ***Jan Fiala*** *Jan Fiala (Gar.)*	Z,ZK	5	2P+2S	Z,L	v
B0M16TEO	**Theology** *Vladimír Slámečka* ***Vladimír Slámečka*** *Vladimír Slámečka (Gar.)*	Z,ZK	5	2P+2S	Z,L	v

Characteristics of the courses of this group of Study Plan: Code=2018_MEKH Name=Humanities subjects

B0M16FIL		Z,ZK	5
B0M16HVT	History of science and technology 2	Z,ZK	5

This subject traces historical developments in electrical engineering branches in the world and in the Czech Lands. Its ultimate goal is to stimulate students' interest in the history and traditions of the subject, while highlighting the developments in technical education and professional organizations, the process of shaping scientific life and the influence of technical engineers

B0M16HSD1	History of economy and social studies	Z,ZK	5

This subject deals with the history of the Czech society in the 19th - 21th centuries. It follows the forming of the Czech political representation, its aims and achieved results as well as the social and cultural development and coexistence of the various ethnical groups in the Czech countries.

B0M16PSM	Psychology	Z,ZK	5
B0M16TEO	Theology	Z,ZK	5

This subject provides to students the basic orientation in christian theology and requires no special previous education. After short philosophic lecture the basic theologic disciplines are gone through. The subject is determined not only to believer students who want to know the reliable theologic grounding but also above all to ones who want to get know Christianity - religion from which graws our civilization up.

Code of the group: MTV
Name of the group: Physical education
Requirement credits in the group:
Requirement courses in the group:
Credits in the group: 0
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
TVV	**Physical education**	Z	0	0+2	Z,L	v
TV-V1	**Physical education**	Z	1	0+2	Z,L	v
TVV0	**Physical education**	Z	0	0+2	Z,L	v
TVKZV	**Physical Education Course**	Z	0	7dní	Z	v
TVKLV	**Physical Education Course**	Z	0	7dní	L	v

Characteristics of the courses of this group of Study Plan: Code=MTV Name=Physical education

TVV	Physical education	Z	0

TV-V1	Physical education	Z	1
TVV0	Physical education	Z	0
TVKZV	Physical Education Course	Z	0
TVKLV	Physical Education Course	Z	0

Code of the group: 2018_MEKVOL
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
B0M16FIL		Z,ZK	5
B0M16HSD1	History of economy and social studies	Z,ZK	5
This subject deals with the history of the Czech society in the 19th - 21th centuries. It follows the forming of the Czech political representation, its aims and achieved results as well as the social and cultural development and coexistence of the various ethnical groups in the Czech countries.			
B0M16HVT	History of science and technology 2	Z,ZK	5
This subject traces historical developments in electrical engineering branches in the world and in the Czech Lands. Its ultimate goal is to stimulate students' interest in the history and traditions of the subject, while highlighting the developments in technical education and professional organizations, the process of shaping scientific life and the influence of technical engineers			
B0M16PSM	Psychology	Z,ZK	5
B0M16TEO	Theology	Z,ZK	5
This subject provides to students the basic orientation in christian theology and requires no special previous education. After short philosophic lecture the basic theologic disciplines are gone through. The subject is determined not only to believer students who want to know the reliable theologic grounding but also above all to ones who want to get know Christianity - religion from which graws our civilization up.			
B2M17ANT	Antennas	Z,ZK	6
Student will get strong knowledge about theory of electromagnetic field radiation and basic principles of antenna design. Methods of analysis are demonstrated on various types of antennas and their arrays. Seminars are both theoretical (analytical and numerical calculation using MATLAB and EM simulators CST) and practical (measurement of antenna parameters).			
B2M17SBS	Wave Propagation for Wireless Links	Z,ZK	6
The aim of the course is to study the wireless transmission channel in real environments focusing on wave propagation for planning of terrestrial and satellite wireless links. The syllabus includes both deeper theoretical foundations of radio wave propagation in the atmosphere as well as ITU-R design procedures for terrestrial and satellite, fixed and mobile communications in various frequency bands.			
B2M31ADAA	Adaptive signal processing	Z,ZK	6
This course provides a basic discourse on adaptive algorithms for filtering, decorrelation, separation and beamforming.			
B2M31AEDA	Experimental Data Analysis	Z,ZK	6
In the course of subject "Experimental Data Analysis", students will acquire knowledge regarding fundamental methods for data analysis and machine learning for evaluation and interpretation of data. In the course of practical lectures, students will solve individual tasks using real data from signal processing in neuroscience research. In the course of semestral project, student will solve complex task and present obtained results. The aim of the subject is to introduce practical application of fundamental statistical methods as well as to teach students to use critical thinking and to acquire additional knowledge in solution of practical tasks.			
B2M31DSP	Advanced DSP methods	Z,ZK	6
The course follows the basic course in signal processing and introduces advanced methods of analysis and digital signal processing. Graduates will learn the methods of digital signals analysis and be able to practically use them. They learn to know the conditions of use of correlation, spectral and coherent analysis of random signals. They will became familiar with methods of signal decomposition and independent component analysis and the time-frequency transformations. Emphasis will be placed on an ability to interpret the results of signal analyses.			
B2M32BTSA	Wireless Technologies	Z,ZK	6
The lectures give overview of fundamental principles of wireless networks in various areas of their application. Students will understand architecture, principles and protocols used in different wireless technologies and learn how these technologies can be exploited in real world applications. The goal is to teach students how to solve problems related to deployment of wireless networks, their operation or development of wireless networks components.			
B2M32DSAA	Network Application Diagnostics	Z,ZK	6
The first part of the course deals with complex network structures, their characteristics identification, with recognition of both structural static and dynamic patterns, and anomaly detection. The second part of the course is focused on specification methods of static and dynamic behavior and their verification. The use of the methods is demonstrated on examples dealing with network application issues. The special treatment is dedicated not only to network and cloud applications, but also to posibilities of diagnostic process automation. The students gain sufficient skills in seminars where they solve practical problems in digital network domain.			
B2M32IBEA	Information Security	Z,ZK	6
The Information Security course provides a complete source of information on the field of security of information systems and information technologies. The most of information in today society is created, transferred, stored in electronic form so information security is very important part of it. Technical background for information security is provided by cryptology.			

B2M32MKSA	Mobile Networks	Z,ZK	6
The lectures introduce principles and functionalities of mobile networks with special focus on currently deployed technologies and future mobile networks. Furthermore, architecture and fundamental principles of GSM, UMTS, LTE/LTE-A, and 5G will be explained. Then, selected key technologies for future mobile networks (6G) will be explained.			
B2M32PST	Advanced Networking Technologies	Z,ZK	6
Subject Advanced Network Technologies expands students' knowledge of modern network technologies. The course is practically oriented and focused on explaining the function of advanced network protocols as used in modern data networks of today and tomorrow. Students will gain practical experience with the issues like Internet routing, software-defined networks, multicast routing, IPv6, and MPLS networks. Part of the course is also devoted to a detailed explanation of transport protocols TCP/UDP and a manner in which software applications can access transportation services of TCP/IP data networks.			
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.			
B2M34NIS	Design of Integrated Circuits	Z,ZK	6
Main tasks of integrated circuits designer; design abstraction levels - Y chart. Definitions of specification, feasibility study, criteria for technology and design kits selection. Integrated systems design and simulation methodologies. Main features of full custom design, gate array, standard cells, programmable array logic. Design aspects of RF and mobile low power systems. Verilog-A, Verilog-AMS, VHDL-A. Logic and physical synthesis. Frond End and Back End design. Floorplanning, place and route, layout, parasitic extraction, time analysis, testbenches design and verification.			
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.			
B2M34SIS	Integrated System Structures	Z,ZK	6
Student learn main design methodologies of analog, digital and optoelectronic integrated systems; Detailed description of the technological process for the IC production; CMOS technologies and its advanced sub-micron trends; IC chip topology, layout and design rules; Technology of micro-electro-mechanical systems MEMS.			
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.			
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.			
B2M37DKM	Digital communications	Z,ZK	6
The course provides fundamentals of digital communications theory: modulation, classical coding, channel models, and basic principles of decoding. The exposition is systematically built along the theoretical lines which allow to reveal all inner connections and principles. This allows students to develop the knowledge and use it in an active way in a design and construction of the communication systems. The course provides a necessary fundamental background for subsequent more advanced communications theory courses.			
B2M37KDKA	Coding in digital communications	Z,ZK	6
This course extends and deepens the topics of the basic communication theory courses in the following main areas. 1) Advanced information theory in coding and Network Information Theory develop a framework for understanding the principles of the channel coding in single-user and multi-node/multi-user scenarios. 2) The algebraic coding presents classical topics of block and convolutional codes. 3) Advanced coding technique focuses on turbo, LDPC, Space-Time codes and Wireless Network Coding. 4) Advanced decoding technique, namely iterative and multi-user decoding is a fundamental tool for decoding capacity approaching channel codes.			
B2M37MAM	Microprocessors	Z,ZK	6
The aim is to make students acquainted with the properties of microprocessor systems, make students familiar with on-chip peripherals, connect external circuit to the processor bus, and with implementation of the memory or I/O space address extension. Next, taught the students to make simple program in the assembly language, C language and combination of both. After completion of this subject student should be able to design and implement simpler microprocessor system including connection of necessary peripherals and software design.			
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			
B3M35PSR	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.			
BDIP25	Diploma Thesis	Z	25
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.			
TV-V1	Physical education	Z	1
TVKLV	Physical Education Course	Z	0
TVKZV	Physical Education Course	Z	0
TVV	Physical education	Z	0
TVV0	Physical education	Z	0