

## Study plan

### Name of study plan: Electronics and Communications - Communication Systems and Networks

Faculty/Institute/Others: Faculty of Electrical Engineering

Department: Department of Telecommunications Engineering

Branch of study guaranteed by the department: Communication Systems and Networks

Garantor of the study branch:

Program of study: Electronics and Communications

Type of study: Follow-up master full-time

Required credits: 97

Elective courses credits: 23

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: 67

The role of the block: P

Code of the group: 2015\_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=2015\_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.		
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Code of the group: 2015\_MEKP1

Name of the group: Compulsory subjects of the programme

Requirement credits in the group: In this group you have to gain 42 credits

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

Credits in the group: 42

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
B2M32MKS	<b>Mobile Networks</b> Pavel Mach, Zdeněk Bečvář, Robert Bešťák <b>Pavel Mach</b> Zdeněk Bečvář (Gar.)	Z,ZK	6	2+2l	Z	P
B2M32DMT	<b>Diagnostics and Measurement in Telecommunications</b> Zdeněk Bečvář, Jiří Vodrážka, Zbyněk Kocur <b>Zdeněk Bečvář</b> Zdeněk Bečvář (Gar.)	Z,ZK	6	2+2l	L	P
B2M37DKM	<b>Digital communications</b> Jan Sýkora <b>Jan Sýkora</b> Jan Sýkora (Gar.)	Z,ZK	6	3p+1c	Z	P
B2M32OSS	<b>Optical Systems and Networks</b> Leoš Boháč <b>Michal Lucki</b> Leoš Boháč (Gar.)	Z,ZK	6	2+2L	L	P
B2M32PST	<b>Advanced Networking Technologies</b> Leoš Boháč <b>Zbyněk Kocur</b> Leoš Boháč (Gar.)	Z,ZK	6	2+2L	Z	P

B2MPROJ6	<b>Project</b> <i>Jiří Jakovenko, Pavel Máša, Ivan Pravda, František Rund, Jan Šístek, Lubor Jirásek, Tomáš Zeman, Ladislav Oppl <b>František Rund</b> František Rund (Gar.)</i>	Z	6	Op+6s		P
B2M32RTK	<b>Telephony Communication Control</b> <i>Robert Bešťák, Pavel Troller <b>Robert Bešťák</b> Robert Bešťák (Gar.)</i>	Z,ZK	6	2+2L	L	P

**Characteristics of the courses of this group of Study Plan: Code=2015\_MEKP1 Name=Compulsory subjects of the programme**

B2M32MKS	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 and LTE-A will be explained. Then, selected key technologies for future mobile networks (e.g., 5G) will be explained.						
B2M32DMT	Diagnostics and Measurement in Telecommunications	Z,ZK	6			
The subject builds on knowledge of basic types of interfaces used in telecommunications (from classic, via a packet-oriented and expected future generation system). Explains the importance of key parameters, presents tools for the monitoring and measurement methodology and fault diagnosis. Students verify acquired knowledge to practical tasks in the laboratory to real systems and advanced measurement techniques.						
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.						
B2M32OSS	Optical Systems and Networks	Z,ZK	6			
The course deals with the use of optical radiation for the transmission of information. The aim is to acquaint students with the functions of important components used in an advanced optical communication systems and networks. Students will learn how to design practical optical fiber link and the network. Students will receive theoretical knowledge for the implementation of a all-optical photonic networks in the future, which will be based on a combination of wavelength multiplex with an all-optical switching.						
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.						
B2M32RTK	Telephony Communication Control	Z,ZK	6			
The course is oriented to audio or video issues in telecommunication networks, both fixed and mobile. Students will learn principles of switching systems and their management as well as the course will provide them with an overview of signaling systems in central exchanges and networks. The focus is on digital switching systems as circuit as packet switch oriented, i.e. so-called next generation network (NGN) and voice communication in 4G networks. (VoLTE).						

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: 2015\_MEKPV1

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 6 courses

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) <i>Tutors, authors and guarantors (gar.)</i>	Completion	Credits	Scope	Semester	Role
B2M32BTS	<b>Wireless Technologies and Sensor Networks</b> <i>Zdeněk Bečvář, Zbyněk Kocur, Lukáš Vojtěch <b>Lukáš Vojtěch</b> Zdeněk Bečvář (Gar.)</i>	Z,ZK	5	2+2l	L	PV
B2M31CZS	<b>Digital Signal processing</b> <i>Pavel Sovka, Petr Pollák <b>Pavel Sovka</b> Pavel Sovka (Gar.)</i>	Z,ZK	5	2p+2c	Z	PV
B2M32DSA	<b>Network Application Diagnostics</b> <i>Radek Mařík <b>Radek Mařík</b> Radek Mařík (Gar.)</i>	Z,ZK	5	2+2c	Z	PV
B2M32DZS	<b>Digital Signal Processing in Telecommunication</b> <i>Boris Šimák, Pavel Zahradník, Michal Šusta <b>Boris Šimák</b> Boris Šimák (Gar.)</i>	Z,ZK	5	2+2l	Z	PV
B2M32DSV	<b>Distributed Computing</b> <i>Lukáš Kencl, Peter Macejko <b>Lukáš Kencl</b> Lukáš Kencl (Gar.)</i>	Z,ZK	5	2+2c	Z	PV
B2M32IBE	<b>Information Security</b> <i>Tomáš Vaněk <b>Tomáš Vaněk</b> Tomáš Vaněk (Gar.)</i>	Z,ZK	5	2+2c	Z	PV
B2M37KDK	<b>Coding in digital communications</b> <i>Jan Sýkora <b>Jan Sýkora</b> Jan Sýkora (Gar.)</i>	Z,ZK	5	3p+1c	L	PV
B2M32PRS	<b>Access Networks</b> <i>Jiří Vodrážka, Tomáš Zeman, Pavel Lafata <b>Pavel Lafata</b> Jiří Vodrážka (Gar.)</i>	Z,ZK	5	2+2L	Z	PV
B2M37RNV	<b>Radio Navigation</b> <i>Pavel Kovář <b>Pavel Kovář</b> Pavel Kovář (Gar.)</i>	Z,ZK	5	2p+2c	L	PV
B2M17SBS	<b>Wave Propagation for Wireless Links</b> <i>Pavel Pechač, Miloš Mazánek <b>Pavel Pechač</b> Pavel Pechač (Gar.)</i>	Z,ZK	6	2P+2C	L	PV

B0M33BDT	<b>Big Data Technologies</b> <i>Petr Paščenko, Marek Sušický Marek Sušický Petr Paščenko (Gar.)</i>	Z,ZK	4	2p+1c	Z	PV
B2M32THO	<b>Queueing Theory</b> <i>Petr Hampl, Jaromír Hrad Petr Hampl Jaromír Hrad (Gar.)</i>	Z,ZK	5	3+1l	Z	PV

**Characteristics of the courses of this group of Study Plan: Code=2015\_MEKPV1 Name=Compulsory subjects of the programme**

B2M32BTS	<b>Wireless Technologies and Sensor Networks</b>	Z,ZK	5			
The lectures give overview of fundamental principles of wireless technologies and wireless sensor 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. Furthermore, student will practice design and configuration of wireless networks including individual communication elements of the network. The goal is to teach students how to solve problems related to deployment of wireless networks, their operation or development of wireless networks and sensor networks components.						
B2M31CZS	<b>Digital Signal processing</b>	Z,ZK	5			
The subject gives overview about basic methods of digital signal processing and their applications (examples from speech and biological signal processing): discrete-time signals and systems, signal characteristics in time and frequency domain, Fourier transform, fast algorithms for DFT computation, introduction to digital filter design, digital filtering in time and frequency domain, decimation and interpolation and their usage in filter banks, basics of LPC analysis. Further details can be found at <a href="http://noel.feld.cvut.cz/vyu/ae2m99czs">http://noel.feld.cvut.cz/vyu/ae2m99czs</a> and <a href="http://noel.feld.cvut.cz/vyu/ae2m99czs/a">http://noel.feld.cvut.cz/vyu/ae2m99czs/a</a>						
B2M32DSA	<b>Network Application Diagnostics</b>	Z,ZK	5			
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 possibilities of diagnostic process automation. The students gain sufficient skills in seminars where they solve practical problems in digital network domain.						
B2M32DZS	<b>Digital Signal Processing in Telecommunication</b>	Z,ZK	5			
The goal of the subject is to make familiar with theory, methods and implementation of algorithms of the digital signal processing of one- and multi-dimensional signals related to the telecommunication technology.						
B2M32DSV	<b>Distributed Computing</b>	Z,ZK	5			
The course is focused on technologies that support distributed computing: on mechanisms ensuring reliable, efficient and secure connection of application processes, programming interfaces of communication channels and up-to-date middleware technologies. A significant part of lectures is dedicated to distributed algorithms that assure causality, exclusive access, deadlock detection/avoidance, fault-tolerance, mobile computing, and security.						
B2M32IBE	<b>Information Security</b>	Z,ZK	5			
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.						
B2M37KDK	<b>Coding in digital communications</b>	Z,ZK	5			
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.						
B2M32PRS	<b>Access Networks</b>	Z,ZK	5			
The course covers the area of high-speed transmission of information in the access network level, with emphasis on the use of optical transmission media and its combination with metallic lines (FTTx). In the practical part, students will learn the methods required for the design, modeling, measurement and analysis of transmission media, diagnostics of systems and whole access networks.						
B2M37RNV	<b>Radio Navigation</b>	Z,ZK	5			
The course introduces students to the terrestrial and satellite radio navigation and radar systems. Students get knowledge of the radio navigation systems, and of the structure of navigation and radar signals and methods of their processing. They become familiar with coordinate systems, fundamentals of celestial mechanics, and methods of position estimation. Students get knowledge of practical applications and the integration of navigation systems.						
B2M17SBS	<b>Wave Propagation for Wireless Links</b>	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.						
B0M33BDT	<b>Big Data Technologies</b>	Z,ZK	4			
The objective of this elective course is to familiarize students with new trends and technologies for storing, management and processing of Big Data. The course will focus on methods for extraction, analysis as well as a selection of hardware infrastructure for managing persistent and streamed data, such as data from social networks. As part of the course we will present how to apply the traditional methods of artificial intelligence and machine learning to Big Data analysis.						
B2M32THO	<b>Queueing Theory</b>	Z,ZK	5			
The aim of the course is to present an overview of dimensioning of telecommunication networks on the basis of results of the queueing theory (QT) and to introduce possibilities of simulation and modelling of networks, both from the point of view of grade of service (GoS) and quality of service (QoS). Results of the QT are applied on different service systems and telecommunication networks being currently operated and developed. Theoretical knowledge about models of service systems can be applied on dimensioning of different service systems in real life - not only on the telecommunications one.						

Name of the block: Elective courses

Minimal number of credits of the block: 0

The role of the block: V

Code of the group: 2015\_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
B0M16FI2	<b>Philosophy 2</b> Peter Zamarovský Peter Zamarovský Peter Zamarovský (Gar.)	Z,ZK	4	2p+2s	L	v
B0M16HT2	<b>History of science and technology 2</b> Marcela Efmertová Marcela Efmertová Marcela Efmertová (Gar.)	Z,ZK	4	2p+2s	L	v
B0M16HSD	<b>History of economy and social studies</b> Marcela Efmertová Marcela Efmertová Marcela Efmertová (Gar.)	Z,ZK	4	2p+2s	L	v
B0M16MPS	<b>Psychology</b> Jan Fiala Jan Fiala (Gar.)	Z,ZK	4	2p+2s	Z,L	v
A003TV	<b>Physical Education</b>	Z	2	0+2	L,Z	v
B0M16TE1	<b>Theology</b> Vladimír Slámečka Vladimír Slámečka Vladimír Slámečka (Gar.)	Z,ZK	4	2p+2s	L	v

**Characteristics of the courses of this group of Study Plan: Code=2015\_MEKH Name=Humanities subjects**

B0M16FI2	Philosophy 2 The course is oriented on the transdisciplinary aspects of philosophy, informatics, physics, mathematics and biology.	Z,ZK	4
B0M16HT2	History of science and technology 2 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	Z,ZK	4
B0M16HSD	History of economy and social studies 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.	Z,ZK	4
B0M16MPS	Psychology	Z,ZK	4
A003TV	Physical Education	Z	2
B0M16TE1	Theology 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 grows our civilization up.	Z,ZK	4

Code of the group: MTV

Name of the group: Tělesná výchova

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	<b>Physical education</b>	Z	0	0+2	Z,L	v
TV-V1	<b>Physical education</b>	Z	1	0+2	Z,L	v
TVV0	<b>Physical education</b>	Z	0	0+2	Z,L	v
TVKLV	<b>Physical Education Course</b>	Z	0	7dní	L	v
TVKZV	<b>Physical Education Course</b>	Z	0	7dní	Z	v

**Characteristics of the courses of this group of Study Plan: Code=MTV Name=Tělesná výchova**

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

Code of the group: 2015\_MEKVOL1

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>

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
B2M31ADA	<b>Adaptive signal processing</b> <i>Pavel Sovka Radoslav Bortel Radoslav Bortel (Gar.)</i>	Z,ZK	5	2p+2c	Z	v
B2M31AED	<b>Eperimental Data Analysis</b> <i>Jan Ruzs Jan Ruzs Jan Ruzs (Gar.)</i>	Z,ZK	5	2p+2c	Z	v
B2M17ANT	<b>Antennas</b> <i>Miloš Mazánek, Pavel Hazdra, Hynek Bártík, Jan Kraček Pavel Hazdra (Gar.)</i>	Z,ZK	6	2P+2L	L	v
B2M37ART	<b>Architecture of radio receivers and transmitters</b> <i>Pavel Kovář, Josef Dobeš Karel Ulovec Josef Dobeš (Gar.)</i>	Z,ZK	6	2p+2l	Z	v
B2M31BSG	<b>Biological Signals</b> <i>Roman Čmejla</i>	Z,ZK	5	2P+2L	L	v
B2M17CAD	<b>CAD in HF Technique</b> <i>Pavel Hazdra, Zbyněk Škvor, Milan Polívka Milan Polívka Zbyněk Škvor (Gar.)</i>	Z,ZK	5	2P+2C	L	v
B2M37DTR	<b>Digital Audio and Video Broadcasting</b> <i>Karel Ulovec, Miloš Klíma, Martin Bernas Karel Fliegel Miloš Klíma (Gar.)</i>	Z,ZK	5	2p+2l	Z	v
B2M34Ezs	<b>Electronic Security Systems</b> <i>Miroslav Husák, Adam Bouřa, Jan Novák, Tomáš Teplý Adam Bouřa Miroslav Husák (Gar.)</i>	Z,ZK	5	2P+2C	Z	v
B2M34SST	<b>Solid State Physics</b> <i>Jan Voves Jan Voves Jan Voves (Gar.)</i>	Z,ZK	6	3P+1L	Z	v
B2M31IAS	<b>Implementation of analog systems</b> <i>Josef Dobeš, Jiří Hospodka, Jiří Náhlík, Ondřej Šubrt Radoslav Bortel Radoslav Bortel (Gar.)</i>	Z,ZK	5	2P+2C	Z	v
B2M37KAS	<b>Compression of images and signals</b> <i>František Rund, Karel Fliegel, Stanislav Vítek Karel Fliegel Stanislav Vítek (Gar.)</i>	Z,ZK	5	2p+2c	L	v
A0M32KMP	<b>Communications and Media Law</b> <i>Zdeněk Brabec, Petr Ondráček Zdeněk Brabec Zdeněk Brabec (Gar.)</i>	Z,ZK	4	2+2c	Z	v
B2M37MAM	<b>Microprocessors</b> <i>Pavel Máša, Stanislav Vítek, Petr Skalický Stanislav Vítek Stanislav Vítek (Gar.)</i>	Z,ZK	6	2p+2l	Z	v
B2M34MST	<b>Microsystems</b> <i>Miroslav Husák, Adam Bouřa Adam Bouřa Miroslav Husák (Gar.)</i>	Z,ZK	6	2P+2L	L	v
B2M17MIM	<b>Microwave Measurements</b> <i>Přemysl Hudec, Tomáš Kořínek, Karel Hoffmann Přemysl Hudec Přemysl Hudec (Gar.)</i>	Z,ZK	5	2P+2L	L	v
B2M37MOT	<b>Advanced areas in image and video technology</b> <i>Karel Fliegel Karel Fliegel Karel Fliegel (Gar.)</i>	Z,ZK	5	2p+2l	Z	v
B2M34NAN	<b>Nanoelectronics and Nanotechnology</b> <i>Jan Voves Jan Voves Jan Voves (Gar.)</i>	Z,ZK	5	2P+2C	L	v
B2M34NIS	<b>Design of Integrated Circuits</b> <i>Jiří Jakovenko, Jan Novák, Vladimír Janíček Jan Novák Jiří Jakovenko (Gar.)</i>	Z,ZK	6	2P+2C	L	v
B2M34NSV	<b>VLSI System Design</b> <i>Pavel Hazdra Pavel Hazdra Pavel Hazdra (Gar.)</i>	Z,ZK	6	2P+2L	Z	v
B2M34ZET	<b>Custom Electronics Design</b> <i>Vít Záhlava Vít Záhlava Vít Záhlava (Gar.)</i>	KZ	5	2P+2L	Z	v
B2M37OBF	<b>Image Photonics</b> <i>Petr Páta Petr Páta Petr Páta (Gar.)</i>	Z,ZK	5	2p+2l	Z	v
B2M37OBT	<b>Image Technology</b> <i>Miloš Klíma, Petr Páta Petr Páta Petr Páta (Gar.)</i>	Z,ZK	6	2p+2l	Z	v
B2M34PIO	<b>Planar integrated optics</b> <i>Vítězslav Jeřábek, Václav Prajzler Václav Prajzler Vítězslav Jeřábek (Gar.)</i>	Z,ZK	5	2P+2C	Z	v
B2M31DSP	<b>Advanced DSP methods</b> <i>Pavel Sovka, Petr Pollák Pavel Sovka Pavel Sovka (Gar.)</i>	Z,ZK	6	2p+2c	Z	v
A0M32PRD	<b>Data Communication Means</b> <i>Tomáš Zeman Tomáš Zeman (Gar.)</i>	Z,ZK	5	2+2L	Z	v
B2M37SSP	<b>Statistical Signal Processing</b> <i>Jan Sýkora, Pavel Sovka Jan Sýkora Jan Sýkora (Gar.)</i>	ZK	5	4p+0	L	v
B2M34SIS	<b>Integrated System Structures</b> <i>Jiří Jakovenko, Vladimír Janíček Vladimír Janíček Jiří Jakovenko (Gar.)</i>	Z,ZK	6	2P+2C	Z	v
A0M37SEK	<b>Synchronization and equalization in digital communications</b> <i>Jan Sýkora Jan Sýkora Jan Sýkora (Gar.)</i>	Z,ZK	4	3+1s	Z	v
B2M31SYN	<b>Synthesis of Audio Signals</b> <i>Roman Čmejla Roman Čmejla Roman Čmejla (Gar.)</i>	Z,ZK	6	2P+2C	Z	v
B2M17VOT	<b>Fiber Optic Technology</b> <i>Jan Sístek, Matěj Komanec, Stanislav Zvánovec Stanislav Zvánovec Stanislav Zvánovec (Gar.)</i>	Z,ZK	6	2P+2L	Z	v
B2M34VKE	<b>Power Electronics</b> <i>Pavel Hazdra, Vít Záhlava, Stanislav Popelka Stanislav Popelka Pavel Hazdra (Gar.)</i>	Z,ZK	5	2P+2L	L	v
B2M31ZAS	<b>Analog Signal Processing</b> <i>Jiří Hospodka Pavel Sovka Jiří Hospodka (Gar.)</i>	Z,ZK	5	2P+2S	L	v

B2M31ZRE	<b>Speech Processing</b> <i>Petr Pollák, Jiří Fiala Petr Pollák Petr Pollák (Gar.)</i>	Z,ZK	6	2p+2c	L	v
B2M99ZVT	<b>Audio technology 1</b> <i>František Rund, Ondřej Jiříček, Libor Husník František Rund Ondřej Jiříček (Gar.)</i>	Z,ZK	6	2p+2l	Z	v
B2M37ZV2	<b>Audio Technology 2</b> <i>František Rund, Libor Husník František Rund František Rund (Gar.)</i>	Z,ZK	5	2p+2l	L	v

### Characteristics of the courses of this group of Study Plan: Code=2015\_MEKVOL1 Name=Elective subjects

B2M31ADA	<b>Adaptive signal processing</b> This course provides a basic discourse on adaptive algorithms for filtering, decorrelation, separation and beamforming. The course explains adaptive algorithms for estimation and prediction, including analysis, implementation and practical applications. Next, it describes the algorithms for adaptive decorrelation and separation of multidimensional signals. Last, the course provides analysis of adaptive beamforming techniques.	Z,ZK	5
B2M31AED	<b>Experimental Data Analysis</b> 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 semester 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.	Z,ZK	5
B2M17ANT	<b>Antennas</b> 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).	Z,ZK	6
B2M37ART	<b>Architecture of radio receivers and transmitters</b> 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.	Z,ZK	6
B2M31BSG	<b>Biological Signals</b> The course is focused to the native and evoked biosignals used in clinical medicine and current methods of capturing, processing, recording and evaluating in the time and frequency domains. For important biological signals, the students are introduced with their genesis, and nature and physiological characteristics of the signals required for construction of instruments. Students are introduced also with the physical and mathematical models. In laboratory exercises, students have the opportunity to capture their own biological signals and their subsequent processing in MATLAB.	Z,ZK	5
B2M17CAD	<b>CAD in HF Technique</b> Introduction into principles and techniques used in modern microwave circuit design.	Z,ZK	5
B2M37DTR	<b>Digital Audio and Video Broadcasting</b> The subject makes students familiar with topics related to video and audio transmission. Described are methods of data stream creation, methods of source and channel coding, error correction principles and modulation formats. Attention is paid to transmission systems standards with regard to transmission channel properties. The subject also deals with multimedia data services and with measurement in transmission systems.	Z,ZK	5
B2M34EZS	<b>Electronic Security Systems</b> The subject describes the system design, electronic solutions, conception characteristics, reliability and its increasing of electronic security and safety systems. It reports solutions of electronic sensor systems and methods of security system design, usage of modern electronic components and microprocessors. It offers practical applications suitable for safety systems of houses, cars, industry companies.	Z,ZK	5
B2M34SST	<b>Solid State Physics</b> The subject is aimed on solid state physics including some parts of statistical physics.	Z,ZK	6
B2M31IAS	<b>Implementation of analog systems</b> 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	5
B2M37KAS	<b>Compression of images and signals</b> The subject deals with compression methods and techniques. Main goal is to introduce basic concepts of lossless and lossy compression of audiovisual information (entropy, redundancy and irrelevancy). Within the laboratory exercises students will work with implementations of particular algorithms, including objective and subjective methods of quality evaluation.	Z,ZK	5
A0M32KMP	<b>Communications and Media Law</b> A complex course dedicated to interdisciplinary problems - the legal aspects of electronic communications (information and communications systems), as well as media from the viewpoint of European and national law. It analyses the areas of informatics, electronic communications, information society services, copyright and general intellectual property rights, the protection of identity, introduction to software law and the Internet as a global communication and information system.	Z,ZK	4
B2M37MAM	<b>Microprocessors</b> 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.	Z,ZK	6
B2M34MST	<b>Microsystems</b> 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.	Z,ZK	6
B2M17MIM	<b>Microwave Measurements</b> 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.	Z,ZK	5

<b>B2M37MOT</b>	<b>Advanced areas in image and video technology</b>	Z,ZK	5
This course focuses on the state-of-the-art techniques for digital image and video technology. These techniques and their applications cover almost all areas of technical professions dealing with human interaction. A significant part of the course is focused on the methods of image signal processing and main hardware and software functional blocks of related imaging systems. The aim of the laboratory exercises is to familiarize with advanced methods for capturing, processing and reproduction of image information. Due to the fast progress in this area, the content of the lectures and exercises is being continuously updated.			
<b>B2M34NAN</b>	<b>Nanoelectronics and Nanotechnology</b>	Z,ZK	5
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.			
<b>B2M34NIS</b>	<b>Design of Integrated Circuits</b>	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. Front End and Back End design. Floorplanning, place and route, layout, parasitic extraction, time analysis, testbenches design and verification.			
<b>B2M34NSV</b>	<b>VLSI System Design</b>	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.			
<b>B2M34ZET</b>	<b>Custom Electronics Design</b>	KZ	5
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.			
<b>B2M37OBF</b>	<b>Image Photonics</b>	Z,ZK	5
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.			
<b>B2M37OBT</b>	<b>Image Technology</b>	Z,ZK	6
This course deals with multimedia technology and it is focused mainly on acquisition, processing and reproduction of image information. It covers area of measurements in photometry, radiometry and colorimetry; design of objective lenses, image sensors and displays including their parameters. Further the course deals with cinematography, photography and with other special methods of image reproduction, e.g. polygraphy and digital printing techniques. Studied problems are completed with explanation of advanced methods of image processing (preprocessing, compression, image reconstruction, etc.).			
<b>B2M34PIO</b>	<b>Planar integrated optics</b>	Z,ZK	5
The subject describes theoretical and technological principles and design of planar integrated optics and optoelectronics as optical dividers, The students get acquainted with the principles of the light propagation in planar waveguide and with basic devices and structures of integrated optics and optoelectronics as coupling elements, optical microresonators, planar optical transmitters and receivers with SS-LD, WG-PD. In the course are integrated devices and structures for telecommunication for multiplexing and signal processing. There are optical elements for physical and chemical sensor application and basic important measurement and diagnostic methods.			
<b>B2M31DSP</b>	<b>Advanced DSP methods</b>	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 become 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.			
<b>A0M32PRD</b>	<b>Data Communication Means</b>	Z,ZK	5
<b>B2M37SSP</b>	<b>Statistical Signal Processing</b>	ZK	5
The course provides fundamentals in three main domains of the statistical signal processing: 1) estimation theory, 2) detection theory, 3) optimal and adaptive filtering. The statistical signal processing is a core theory with many applications ranging from digital communications, audio and video processing, radar and radio navigation, measurement and experiment evaluation, etc.			
<b>B2M34SIS</b>	<b>Integrated System Structures</b>	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.			
<b>A0M37SEK</b>	<b>Synchronization and equalization in digital communications</b>	Z,ZK	4
We explain principles of the receiver signal processing (synchronization and equalization) for the parametric channel including variety of the implementation possibilities. We focus on the essential particular forms of the channel phase, frequency and timing parameterization, channels with multipath propagation and MIMO channels. We develop the ideas of synchronization and equalization in the context of the data decoding in the parametric channel. All basic categories of the CSE algorithms are targeted: feed-forward, feed-back, iterative and recursive, including the theoretical background of the parameter estimation theory, and theory of the feed-back and iterative systems.			
<b>B2M31SYN</b>	<b>Synthesis of Audio Signals</b>	Z,ZK	6
This course introduces the fundamentals of sound synthesis algorithms (everyday, music and speech), digital audio effects and sonification. Audio synthetic signals are used in modern digital systems, virtual reality systems, computer animations, games and film. Understanding of theoretical concepts will be consolidated through practical programming assignments in Matlab.			
<b>B2M17VOT</b>	<b>Fiber Optic Technology</b>	Z,ZK	6
The aim of the course is to introduce mechanisms of propagation of optical waves in optical fibers and fiber components. Furthermore, the optical measuring techniques and measuring methods for the characterization of optical fibers will be presented. Lectures include both the design and methodology of measuring transmission parameters for optical communication systems such as numerical aperture, attenuation, dispersion, and measurement of basic characteristics of active and passive elements of optical communication systems - connectors, splices, couplers, refractive indices etc.			
<b>B2M34VKE</b>	<b>Power Electronics</b>	Z,ZK	5
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.			
<b>B2M31ZAS</b>	<b>Analog Signal Processing</b>	Z,ZK	5
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.			

B2M31ZRE	Speech Processing	Z,ZK	6
The subject is devoted to basis of speech processing addressed to students of master program. Discussed speech technology is currently applied in many systems in different fields (e.g. information dialogue systems, voice controlled devices, dictation systems or transcription of audio-video recordings, support for language teaching, etc.). Students will learn basic algorithms for speech analysis (spectral analysis, LPC, cepstral analysis, pitch, formants, etc.), principles of speech recognition (GMM-HMM, ANN-HMM systems, small and large vocabulary recognizers), speaker recognition (based on VQ and GMM), speech synthesis or speech enhancement. Further information can be found at &lt;a href=http://noel.feld.cvut.cz/vyu/ae2m31zre&gt;http://noel.feld.cvut.cz/vyu/ae2m31zre&lt;/a&gt;. Pro zapsané studenty jsou detailní informace na výukovém portálu &lt;a href=https://moodle.fel.cvut.cz&gt;Moodle FEL&lt;/a&gt;.			
B2M99ZVT	Audio technology 1	Z,ZK	6
The course provides fundamentals of physical acoustics and acoustic measurement, including problems of noise from technical and perceptual point of view. In the second part principles of electroacoustic and electromechanical transducers are explained along with their analysis. Principles of sound compressing systems and spacial sound processing are also treated.			
B2M37ZV2	Audio Technology 2	Z,ZK	5
This course deals with advanced topics related to audio technology in recording studios, namely room acoustics, multichannel signal recording and reproduction, digital audio signal processing, its impact on auditory perception, audio signal optimization from the psychoacoustic point of view.			

### List of courses of this pass:

Code	Name of the course	Completion	Credits
A003TV	Physical Education	Z	2
A0M32KMP	Communications and Media Law A complex course dedicated to interdisciplinary problems - the legal aspects of electronic communications (information and communications systems), as well as media from the viewpoint of European and national law. It analyses the areas of informatics, electronic communications, information society services, copyright and general intellectual property rights, the protection of identity, introduction to software law and the Internet as a global communication and information system.	Z,ZK	4
A0M32PRD	Data Communication Means	Z,ZK	5
A0M37SEK	Synchronization and equalization in digital communications We explain principles of the receiver signal processing (synchronization and equalization) for the parametric channel including variety of the implementation possibilities. We focus on the essential particular forms of the channel phase, frequency and timing parameterization, channels with multipath propagation and MIMO channels. We develop the ideas of synchronization and equalization in the context of the data decoding in the parametric channel. All basic categories of the CSE algorithms are targeted: feed-forward, feed-back, iterative and recursive, including the theoretical background of the parameter estimation theory, and theory of the feed-back and iterative systems.	Z,ZK	4
B0M16FI2	Philosophy 2 The course is oriented on the transdisciplinary aspects of philosophy, informatics, physics, mathematics and biology.	Z,ZK	4
B0M16HSD	History of economy and social studies 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.	Z,ZK	4
B0M16HT2	History of science and technology 2 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	Z,ZK	4
B0M16MPS	Psychology	Z,ZK	4
B0M16TE1	Theology 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 grows our civilization up.	Z,ZK	4
B0M33BDT	Big Data Technologies The objective of this elective course is to familiarize students with new trends and technologies for storing, management and processing of Big Data. The course will focus on methods for extraction, analysis as well as a selection of hardware infrastructure for managing persistent and streamed data, such as data from social networks. As part of the course we will present how to apply the traditional methods of artificial intelligence and machine learning to Big Data analysis.	Z,ZK	4
B2M17ANT	Antennas 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).	Z,ZK	6
B2M17CAD	CAD in HF Technique Introduction into principles and techniques used in modern microwave circuit design.	Z,ZK	5
B2M17MIM	Microwave Measurements 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.	Z,ZK	5
B2M17SBS	Wave Propagation for Wireless Links 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.	Z,ZK	6



B2M17VOT	Fiber Optic Technology	Z,ZK	6
The aim of the course is to introduce mechanisms of propagation of optical waves in optical fibers and fiber components. Furthermore, the optical measuring techniques and measuring methods for the characterization of optical fibers will be presented. Lectures include both the design and methodology of measuring transmission parameters for optical communication systems such as numerical aperture, attenuation, dispersion, and measurement of basic characteristics of active and passive elements of optical communication systems - connectors, splices, couplers, refractive indices etc.			
B2M31ADA	Adaptive signal processing	Z,ZK	5
This course provides a basic discourse on adaptive algorithms for filtering, decorrelation, separation and beamforming. The course explains adaptive algorithms for estimation and prediction, including analysis, implementation and practical applications. Next, it describes the algorithms for adaptive decorrelation and separation of multidimensional signals. Last, the course provides analysis of adaptive beamforming techniques.			
B2M31AED	Eperimental Data Analysis	Z,ZK	5
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.			
B2M31BSG	Biological Signals	Z,ZK	5
The course is focused to the native and evoked biosignals used in clinical medicine and current methods of capturing, processing, recording and evaluating in the time and frequency domains. For important biological signals, the students are introduced with their genesis, and nature and physiological characteristics of the signals required for construction of instruments. Students are introduced also with the physical and mathematical models. In laboratory exercises, students have the opportunity to capture their own biological signals and their subsequent processing in MATLAB.			
B2M31CZS	Digital Signal processing	Z,ZK	5
The subject gives overview about basic methods of digital signal processing and their applications (examples from speech and biological signal processing): discrete-time signals and systems, signal characteristics in time and frequency domain, Fourier transform, fast algorithms for DFT computation, introduction to digital filter design, digital filtering in time and frequency domain, decimation and interpolation and their usage in filter banks, basics of LPC analysis. Further details can be found at &lt;a href=http://noel.feld.cvut.cz/vyu/ae2m99czs&gt;http://noel.feld.cvut.cz/vyu/ae2m99czs&lt;/a&gt;			
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.			
B2M31IAS	Implementation of analog systems	Z,ZK	5
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.			
B2M31SYN	Synthesis of Audio Signals	Z,ZK	6
This course introduces the fundamentals of sound synthesis algorithms (everyday, music and speech), digital audio effects and sonification. Audio synthetic signals are used in modern digital systems, virtual reality systems, computer animations, games and film. Understanding of the theoretical concepts will be consolidated through practical programming assignments in Matlab.			
B2M31ZAS	Analog Signal Processing	Z,ZK	5
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.			
B2M31ZRE	Speech Processing	Z,ZK	6
The subject is devoted to basis of speech processing addressed to students of master program. Discussed speech technology is currently applied in many systems in different fields (e.g. information dialogue systems, voice controlled devices, dictation systems or transcription of audio-video recordings, support for language teaching, etc.). Students will learn basic algorithms for speech analysis (spectral analysis, LPC, cepstral analysis, pitch, formants, etc.), principles of speech recognition (GMM-HMM, ANN-HMM systems, small and large vocabulary recognizers), speaker recognition (based on VQ and GMM), speech synthesis or speech enhancement. Further information can be found at &lt;a href=http://noel.feld.cvut.cz/vyu/ae2m31zre&gt;http://noel.feld.cvut.cz/vyu/ae2m31zre&lt;/a&gt;. Pro zapsané studenty jsou detailní informace na výukovém portálu &lt;a href=https://moodle.fel.cvut.cz&gt;https://moodle.fel.cvut.cz&lt;/a&gt;.			
B2M32BTS	Wireless Technologies and Sensor Networks	Z,ZK	5
The lectures give overview of fundamental principles of wireless technologies and wireless sensor 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. Furthermore, student will practice design and configuration of wireless networks including individual communication elements of the network. The goal is to teach students how to solve problems related to deployment of wireless networks, their operation or development of wireless networks and sensor networks components.			
B2M32DMT	Diagnostics and Measurement in Telecommunications	Z,ZK	6
The subject builds on knowledge of basic types of interfaces used in telecommunications (from classic, via a packet-oriented and expected future generation system). Explains the importance of key parameters, presents tools for the monitoring and measurement methodology and fault diagnosis. Students verify acquired knowledge to practical tasks in the laboratory to real systems and advanced measurement techniques.			
B2M32DSA	Network Application Diagnostics	Z,ZK	5
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 possibilities of diagnostic process automation. The students gain sufficient skills in seminars where they solve practical problems in digital network domain.			
B2M32DSV	Distributed Computing	Z,ZK	5
The course is focused on technologies that support distributed computing: on mechanisms ensuring reliable, efficient and secure connection of application processes, programming interfaces of communication channels and up-to-date middleware technologies. A significant part of lectures is dedicated to distributed algorithms that assure causality, exclusive access, deadlock detection/avoidance, fault-tolerance, mobile computing, and security.			
B2M32DZS	Digital Signal Processing in Telecommunication	Z,ZK	5
The goal of the subject is to make familiar with theory, methods and implementation of algorithms of the digital signal processing of one- and multi-dimensional signals related to the telecommunication technology.			

B2M32IBE	Information Security	Z,ZK	5
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.			
B2M32MKS	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 and LTE-A will be explained. Then, selected key technologies for future mobile networks (e.g., 5G) will be explained.			
B2M32OSS	Optical Systems and Networks	Z,ZK	6
The course deals with the use of optical radiation for the transmission of information. The aim is to acquaint students with the functions of important components used in an advanced optical communication systems and networks. Students will learn how to design practical optical fiber link and the network. Students will receive theoretical knowledge for the implementation of a all-optical photonic networks in the future, which will be based on a combination of wavelength multiplex with an all-optical switching.			
B2M32PRS	Access Networks	Z,ZK	5
The course covers the area of high-speed transmission of information in the access network level, with emphasis on the use of optical transmission media and its combination with metallic lines (FTTx). In the practical part, students will learn the methods required for the design, modeling, measurement and analysis of transmission media, diagnostics of systems and whole access networks.			
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.			
B2M32RTK	Telephony Communication Control	Z,ZK	6
The course is oriented to audio or video issues in telecommunication networks, both fixed and mobile. Students will learn principles of switching systems and their management as well as the course will provide them with an overview of signaling systems in central exchanges and networks. The focus is on digital switching systems as circuit as packet switch oriented, i.e. so-called next generation network (NGN) and voice communication in 4G networks. (VoLTE).			
B2M32THO	Queueing Theory	Z,ZK	5
The aim of the course is to present an overview of dimensioning of telecommunication networks on the basis of results of the queueing theory (QT) and to introduce possibilities of simulation and modelling of networks, both from the point of view of grade of service (GoS) and quality of service (QoS). Results of the QT are applied on different service systems and telecommunication networks being currently operated and developed. Theoretical knowledge about models of service systems can be applied on dimensioning of different service systems in real life - not only on the telecommunications one.			
B2M34Ezs	Electronic Security Systems	Z,ZK	5
The subject describes the system design, electronic solutions, conception characteristics, reliability and its increasing of electronic security and safety systems. It reports solutions of electronic sensor systems and methods of security system design, usage of modern electronic components and microprocessors. It offers practical applications suitable for safety systems of houses, cars, industry companies.			
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.			
B2M34NAN	Nanoelectronics and Nanotechnology	Z,ZK	5
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.			
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. Front 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.			
B2M34PIO	Planar integrated optics	Z,ZK	5
he subject describes theoretical and technological principles and design of planar integrated optics and optoelectronics as optical dividers, The students get acquainted with the principles of the light propagation in planar waveguide and with basic devices and structures of integrated optics and optoelectronics as coupling elements, optical microresonators, planar optical transmitters an receivers with SS-LD, WG-PD . In the course are integrated devices and structures for telecommunication for multiplexing and signal processing. There are optical elements for physical and chemical sensor application and basic important measurement and diagnostic methods.			
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.			
B2M34SST	Solid State Physics	Z,ZK	6
The subject is aimed on solid state physics including some parts of statistical physics.			
B2M34VKE	Power Electronics	Z,ZK	5
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.			
B2M34ZET	Custom Electronics Design	KZ	5
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.			
B2M37DTR	Digital Audio and Video Broadcasting	Z,ZK	5
The subject makes students familiar with topics related to video and audio transmission. Described are methods of data stream creation, methods of source and channel coding, error correction principles and modulation formats. Attention is paid to transmission systems standards with regard to transmission channel properties. The subject also deals with multimedia data services and with measurement in transmission systems.			
B2M37KAS	Compression of images and signals	Z,ZK	5
The subject deals with compression methods and techniques. Main goal is to introduce basic concepts of lossless and lossy compression of audiovisual information (entropy, redundancy and irrelevancy). Within the laboratory exercises students will work with implementations of particular algorithms, including objective and subjective methods of quality evaluation.			
B2M37KDK	Coding in digital communications	Z,ZK	5
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.			
B2M37MOT	Advanced areas in image and video technology	Z,ZK	5
This course focuses on the state-of-the-art techniques for digital image and video technology. These techniques and their applications cover almost all areas of technical professions dealing with human interaction. A significant part of the course is focused on the methods of image signal processing and main hardware and software functional blocks of related imaging systems. The aim of the laboratory exercises is to familiarize with advanced methods for capturing, processing and reproduction of image information. Due to the fast progress in this area, the content of the lectures and exercises is being continuously updated.			
B2M37OBF	Image Photonics	Z,ZK	5
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.			
B2M37OBT	Image Technology	Z,ZK	6
This course deals with multimedia technology and it is focused mainly on acquisition, processing and reproduction of image information. It covers area of measurements in photometry, radiometry and colorimetry; design of objective lenses, image sensors and displays including their parameters. Further the course deals with cinematography, photography and with other special methods of image reproduction, e.g. polygraphy and digital printing techniques. Studied problems are completed with explanation of advanced methods of image processing (preprocessing, compression, image reconstruction, etc.).			
B2M37RNV	Radio Navigation	Z,ZK	5
The course introduces students to the terrestrial and satellite radio navigation and radar systems. Students get knowledge of the radio navigation systems, and of the structure of navigation and radar signals and methods of their processing. They become familiar with coordinate systems, fundamentals of celestial mechanics, and methods of position estimation. Students get knowledge of practical applications and the integration of navigation systems.			
B2M37SSP	Statistical Signal Processing	ZK	5
The course provides fundamentals in three main domains of the statistical signal processing: 1) estimation theory, 2) detection theory, 3) optimal and adaptive filtering. The statistical signal processing is a core theory with many applications ranging from digital communications, audio and video processing, radar and radio navigation, measurement and experiment evaluation, etc.			
B2M37ZV2	Audio Technology 2	Z,ZK	5
This course deals with advanced topics related to audio technology in recording studios, namely room acoustics, multichannel signal recording and reproduction, digital audio signal processing, its impact on auditory perception, audio signal optimization from the psychoacoustic point of view.			
B2M99ZVT	Audio technology 1	Z,ZK	6
The course provides fundamentals of physical acoustics and acoustic measurement, including problems of noise from technical and perceptual point of view. In the second part principles od electroacoustic and electromechanical transducers are explained along with their analysis. Principles of sound compressing systems and spacial sound processing are also treated.			
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.			
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

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

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