Study plan

Name of study plan: Electronics and Communications

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: 49
The role of the block: P

Code of the group: 2021_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=2021_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: 2021_MEKP8
Name of the group: Compulsory subjects of the programme
Requirement credits in the group: In this group you have to gain 24 credits
Requirement courses in the group: In this group you have to complete 4 courses
Credits in the group: 24
Note on the group: Specializace Komunikace a zpracování informace (KZI)

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
B2M31DSP	**Advanced DSP methods** *Pavel Sovka, Petr Pollák **Pavel Sovka** Pavel Sovka (Gar.)*	Z,ZK	6	2P+2C	Z,L	P
B2MPROJ6	**Project** *Jiří Jakovenko, Pavel Máša, Ivan Pravda, František Rund, Jan Šístek, Lubor Jirásek, Tomáš Zeman, Ladislav Oppl **František Rund** František Rund (Gar.)*	Z	6	0p+6s	Z,L	P

Characteristics of the courses of this group of Study Plan: Code=2021_MEKP8 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.			
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.			
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			

Name of the block: Compulsory elective courses
Minimal number of credits of the block: 60
The role of the block: PV

Code of the group: 2021_MEKPV8B
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 Komunikace a zpracování informace (KZI)

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
B2M37CIR	**Implementation of the digital circuits in Radio** *Petr Skalický, Stanislav Vítek* ***Stanislav Vítek*** *Petr Skalický (Gar.)*	Z,ZK	6	2P+2L	L	PV
B4M33DZO	**Digital image** *Ondřej Drbohlav, Daniel Sýkora* ***Daniel Sýkora*** *Daniel Sýkora (Gar.)*	Z,ZK	6	2P+2C	Z,L	PV
B2M32IBEA	**Information Security** *Tomáš Vaněk* ***Petr Hampl*** *Leoš Boháč (Gar.)*	Z,ZK	6	2P + 2C	L	PV
B3M35ORR	**Optimal and Robust Control** *Zdeněk Hurák* ***Zdeněk Hurák*** *Zdeněk Hurák (Gar.)*	Z,ZK	6	2P+2C	L	PV
B3M35PSR	**Real -Time Systems Programming** *Michal Sojka* ***Michal Sojka*** *Michal Sojka (Gar.)*	Z,ZK	6	2P+2C	Z	PV
B4M33SSU	**Statistical Machine Learning**	Z,ZK	6	2P+2C	Z	PV
B2M17SBS	**Wave Propagation for Wireless Links** *Pavel Pechač* ***Pavel Pechač*** *Pavel Pechač (Gar.)*	Z,ZK	6	2P+2C	L	PV
B2M32THOA	**Queueing Theory** *Petr Hampl* ***Petr Hampl*** *Petr Hampl (Gar.)*	Z,ZK	6	3P + 1L	Z	PV
B2M01TIK	**Information Theory and Coding**	Z,ZK	6	3P+1C	L	PV

Characteristics of the courses of this group of Study Plan: Code=2021_MEKPV8B 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.			
B2M37CIR	Implementation of the digital circuits in Radio	Z,ZK	6
The course is base for student, which want practically designed circuits of the digital signal processing with the signal processors and specialised circuits. Attention is concentration to realisation of the modulators and circuit of the numerical conversion of the signal, algoritms coding/decoding, which contains in the communication chain. Dominantly is concentration to effective realization with minimal computing power.			
B4M33DZO	Digital image	Z,ZK	6
This course presents an overview of basic methods for digital image processing. It deals with practical techniques that have an interesting theoretical basis but are not difficult to implement. Seemingly abstract concepts from mathematical analysis, probability theory, or optimization come to life through visually engaging applications. The course focuses on fundamental principles (signal sampling and reconstruction, monadic operations, histogram, Fourier transform, convolution, linear and non-linear filtering) and more advanced editing techniques, including image stitching, deformation, registration, and segmentation. Students will practice the selected topics through six implementation tasks, which will help them learn the theoretical knowledge from the lectures and use it to solve practical problems			
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.			
B3M35ORR	Optimal and Robust Control	Z,ZK	6

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.

B4M33SSU	Statistical Machine Learning	Z,ZK	6

The aim of statistical machine learning is to develop systems (models and algorithms) able to learn to solve tasks given a set of examples and some prior knowledge about the task. This includes typical tasks in speech and image recognition. The course has the following two main objectives 1. to present fundamental learning concepts such as risk minimisation, maximum likelihood estimation and Bayesian learning including their theoretical aspects, 2. to consider important state-of-the-art models for classification and regression and to show how they can be learned by those concepts.

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.

B2M32THOA	Queueing Theory	Z,ZK	6

The aim of the course is to present an overview of dimensioning of telecommunication networks on the basis of results of the queuing 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.

B2M01TIK	Information Theory and Coding	Z,ZK	6

Fundamentals of information theory with a view towards efficient data compression and reliable transmission of information using selfcorrecting codes.

Code of the group: 2021_MEKPV8A
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 Komunikace a zpracování informace (KZI)

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
B3M35DRS	**Dynamics and Control Networks** *Kristian Hengster-Movric* ***Kristian Hengster-Movric***	Z,ZK	6	2P+2C	Z	PV
B2M37KDKA	**Coding in digital communications** *Jan Sýkora* ***Jan Sýkora*** *Jan Sýkora (Gar.)*	Z,ZK	6	3P+1C	L	PV
B2M37KASA	**Compression of images and signals** *Stanislav Vítek, František Rund, Karel Fliegel, Václav Vencovský* ***Karel Fliegel*** *Stanislav Vítek (Gar.)*	Z,ZK	6	2P+2C	L	PV
B2M32MKSA	**Mobile Networks** *Zdeněk Bečvář, Pavel Mach, Robert Bešťák* ***Pavel Mach*** *Zdeněk Bečvář (Gar.)*	Z,ZK	6	2P + 2L	Z	PV
B2M37SEK	**Synchronization and equalization in digital communications** *Jan Sýkora* ***Jan Sýkora*** *Jan Sýkora (Gar.)*	Z,ZK	6	3P+1C	Z	PV

Characteristics of the courses of this group of Study Plan: Code=2021_MEKPV8A Name=Compulsory subjects of the programme

B3M35DRS	Dynamics and Control Networks	Z,ZK	6

This course responds to an ever-increasing demand for understanding contemporary networks large-scale complex systems composed of many components and subsystems interconnected into a single distributed entity. Herein, we will consider fundamental similarities between diverse areas such as e.g. forecasting the spread of global pandemics, public opinion dynamics and manipulation of communities through social media, formation controls for unmanned vehicles, energy generation and distribution in power grids, etc. Understanding such compelling issues goes far beyond the boundaries of any single physical, technological or scientific domain. Therefore, we will analyze phenomena across different domains, involving societal, economic and biological networks. For such networked systems, the resulting behavior depends not only on the characteristics of their individual components and details of their physical or logical interactions, but also on a precise way those components are interconnected the detailed interconnection topology. For that reason, the first part of the course introduces fundamental theoretical and abstract computational network analysis concepts; in particular, the algebraic graph theory, network measures and metrics and fundamental network algorithms. The second part of the course subsequently views networks as dynamical systems, studies their properties and ways in which these are controlled, using mainly methods of automatic control theory.

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.

B2M37KASA	Compression of images and signals	Z,ZK	6

The subject deals with compression methods and techniques. Main goal is to introduce basic concepts of lossless and lossy compresion 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.

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.

B2M37SEK	Synchronization and equalization in digital communications	Z,ZK	6

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.

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

Code of the group: 2021_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
A003TV	**Physical Education** ***Jiří Drnek***	Z	2	0+2	L,Z	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=2021_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
A003TV	Physical Education	Z	2
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
A003TV	**Physical Education** ***Jiří Drnek***	Z	2	0+2	L,Z	v
TV-V1	**Physical education**	Z	1	0+2	Z,L	v
TVV0	**Physical education**	Z	0	0+2	Z,L	v
TVKLV	**Physical Education Course**	Z	0	7dní	L	v

TVKZV	**Physical Education Course**	Z	0	7dní	Z	v

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

A003TV	Physical Education	Z	2
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: 2021_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
A003TV	Physical Education	Z	2
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.			
B2M01TIK	Information Theory and Coding	Z,ZK	6
Fundamentals of information theory with a view towards efficient data compression and reliable transmission of information using selfcorrecting codes.			
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.			
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.			
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.			
B2M32THOA	Queueing Theory	Z,ZK	6
The aim of the course is to present an overview of dimensioning of telecommunication networks on the basis of results of the queuing 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.		
B2M37CIR	Implementation of the digital circuits in Radio	Z,ZK	6
	The course is base for student, which want practically designed circuits of the digital signal processing with the signal processors and specialised circuits. Attention is concentration to realisation of the modulators and circuit of the numerical conversion of the signal, algoritms coding/decoding, which contains in the communication chain. Dominantly is concentration to effective realization with minimal computing power.		
B2M37KASA	Compression of images and signals	Z,ZK	6
	The subject deals with compression methods and techniques. Main goal is to introduce basic concepts of lossless and lossy compresion 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.		
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.		
B2M37SEK	Synchronization and equalization in digital communications	Z,ZK	6
	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.		
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		
B3M35DRS	Dynamics and Control Networks	Z,ZK	6
	This course responds to an ever-increasing demand for understanding contemporary networks large-scale complex systems composed of many components and subsystems interconnected into a single distributed entity. Herein, we will consider fundamental similarities between diverse areas such as e.g. forecasting the spread of global pandemics, public opinion dynamics and manipulation of communities through social media, formation controls for unmanned vehicles, energy generation and distribution in power grids, etc. Understanding such compelling issues goes far beyond the boundaries of any single physical, technological or scientific domain. Therefore, we will analyze phenomena across different domains, involving societal, economic and biological networks. For such networked systems, the resulting behavior depends not only on the characteristics of their individual components and details of their physical or logical interactions, but also on a precise way those components are interconnected the detailed interconnection topology. For that reason, the first part of the course introduces fundamental theoretical and abstract computational network analysis concepts; in particular, the algebraic graph theory, network measures and metrics and fundamental network algorithms. The second part of the course subsequently views networks as dynamical systems, studies their properties and ways in which these are controlled, using mainly methods of automatic control theory.		
B3M35ORR	Optimal and Robust Control	Z,ZK	6
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.		
B4M33DZO	Digital image	Z,ZK	6
	This course presents an overview of basic methods for digital image processing. It deals with practical techniques that have an interesting theoretical basis but are not difficult to implement. Seemingly abstract concepts from mathematical analysis, probability theory, or optimization come to life through visually engaging applications. The course focuses on fundamental principles (signal sampling and reconstruction, monadic operations, histogram, Fourier transform, convolution, linear and non-linear filtering) and more advanced editing techniques, including image stitching, deformation, registration, and segmentation. Students will practice the selected topics through six implementation tasks, which will help them learn the theoretical knowledge from the lectures and use it to solve practical problems		
B4M33SSU	Statistical Machine Learning	Z,ZK	6
	The aim of statistical machine learning is to develop systems (models and algorithms) able to learn to solve tasks given a set of examples and some prior knowledge about the task. This includes typical tasks in speech and image recognition. The course has the following two main objectives 1. to present fundamental learning concepts such as risk minimisation, maximum likelihood estimation and Bayesian learning including their theoretical aspects, 2. to consider important state-of-the-art models for classification and regression and to show how they can be learned by those concepts.		
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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