Study plan

Name of study plan: Electronics and Communications - Radio Systems

Faculty/Institute/Others: Faculty of Electrical Engineering
Department:
Branch of study guaranteed by the department: Welcome page
Garantor of the study branch:
Program of study: Electronics and Communications
Type of study: Follow-up master full-time
Required credits: 109
Elective courses credits: 11
Sum of credits in the plan: 120
Note on the plan:

Name of the block: Compulsory courses in the program
Minimal number of credits of the block: 79
The role of the block: P

Code of the group: 2018_MEKEP7
Name of the group: Compulsory subjects of the programme
Requirement credits in the group: In this group you have to gain 54 credits
Requirement courses in the group: In this group you have to complete 9 courses
Credits in the group: 54
Note on the group: Specializace radiové systémy

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
BE2M17ANT	**Antennas** *Pavel Hazdra, Miloš Mazánek, Jan Kraček* ***Jan Kraček*** *Miloš Mazánek (Gar.)*	Z,ZK	6	2P+2L	L	P
BE2M37ART	**Architecture of Radio Receivers and Transmitters** *Josef Dobeš, Pavel Kovář* ***Karel Ulovec*** *Pavel Kovář (Gar.)*	Z,ZK	6	2P+2L	Z	P
BE2M37DKM	**Digital Communications** *Pavel Puričer, Jan Sýkora* ***Pavel Puričer*** *Jan Sýkora (Gar.)*	Z,ZK	6	3P+1C	Z	P
BE2M31DSPA	**Digital Signal Processing** *Petr Pollák* ***Petr Pollák*** *Petr Pollák (Gar.)*	Z,ZK	6	2P+2C	Z	P
BE2M37MAM	**Microprocessors** *Stanislav Vítek* ***Stanislav Vítek*** *Stanislav Vítek (Gar.)*	Z,ZK	6	2P+2L	Z	P
BE2M17MIOA	**Microwave Circuits** *Přemysl Hudec, Karel Hoffmann* ***Přemysl Hudec*** *Milan Polívka (Gar.)*	Z,ZK	6	2P+2C	Z	P
BE2MPROJ6	**Project** *Jan Šístek, Pavel Máša, Ivan Pravda, Lubor Jirásek, Zdeněk Bečvář, František Rund* ***František Rund*** *František Rund (Gar.)*	Z	6	0p+6s		P
BE2M17SBS	**Wave Propagation for Wireless Links** *Pavel Pechač* ***Pavel Pechač*** *Pavel Pechač (Gar.)*	Z,ZK	6	2P+2C	L	P
BE2M32BTSA	**Wireless Technologies** *Zdeněk Bečvář, Lukáš Vojtěch, Zbyněk Kocur, Pavel Mach* ***Ján Kučerák*** *Zdeněk Bečvář (Gar.)*	Z,ZK	6	2P + 2L	Z,L	P

Characteristics of the courses of this group of Study Plan: Code=2018_MEKEP7 Name=Compulsory subjects of the programme

BE2M17ANT	Antennas	Z,ZK	6
Student will get strong knowledge about theory of electromagnetic field radiation and basic principles of antenna design. Methods of analysis are demonstrated on various types of antennas and their arrays. Seminars are both theoretical (analytical and numerical calculation using MATLAB and EM simulators CST) and practical (measurement of antenna parameters).			
BE2M37ART	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.			
BE2M37DKM	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.			

BE2M31DSPA	Digital Signal Processing	Z,ZK	6
The subject gives overview about basic methods of digital signal processing and their applications (examples from speech and biological signal processing): disrete-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 http://noel.feld.cvut.cz/vyu/be2m31dspa .			
BE2M37MAM	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.			
BE2M17MIOA	Microwave Circuits	Z,ZK	6
Subject is focused on the design of planar passive and active microwave circuits.			
BE2MPROJ6	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. List of possible topics: http://www.fel.cvut.cz/en/education/semestral-projects.html			
BE2M17SBS	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.			
BE2M32BTSA	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.			

Code of the group: 2018_MEKEDIP
Name of the group: Diploma Thesis
Requirement credits in the group: In this group you have to gain 25 credits
Requirement courses in the group: In this group you have to complete 1 course
Credits in the group: 25
Note on the group:

Code	Name of the course / Name of the group of courses *(in case of groups of courses the list of codes of their members)* *Tutors,* ***authors*** *and guarantors (gar.)*	Completion	Credits	Scope	Semester	Role
BDIP25	**Diploma Thesis**	Z	25	22s	L	P

Characteristics of the courses of this group of Study Plan: Code=2018_MEKEDIP 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.			

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

Code of the group: 2018_MEKEPV7
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 radiové systémy

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
BE2M17CADA	**CAD in HF Technique** *Zbyněk Škvor* ***Zbyněk Škvor*** *Zbyněk Škvor (Gar.)*	Z,ZK	6	2P+2C	L	PV
BE2M37DTRA	**Digital Audio and Video Broadcasting** ***Karel Ulovec***	Z,ZK	6	2P+2L	Z	PV
BE2M17MIMA	**Microwave Measurements** *Přemysl Hudec, Karel Hoffmann* ***Viktor Adler*** *Přemysl Hudec (Gar.)*	Z,ZK	6	2P+2L	L	PV
BE2M32MKSA	**Mobile Networks** *Zdeněk Bečvář, Pavel Mach, Robert Bešťák* ***Pavel Mach*** *Zdeněk Bečvář (Gar.)*	Z,ZK	6	2P + 2L	Z	PV
BE2M37RNVA	**Radio Navigation** *Pavel Kovář* ***Pavel Kovář*** *Pavel Kovář (Gar.)*	Z,ZK	6	2P+2L	Z	PV

BE2M34NSV	**VLSI System Design** *Pavel Hazdra* ***Pavel Hazdra*** *Pavel Hazdra (Gar.)*	Z,ZK	6	2P+2L	Z	PV

Characteristics of the courses of this group of Study Plan: Code=2018_MEKEPV7 Name=Compulsory subjects of the programme

BE2M17CADA	CAD in HF Technique	Z,ZK	6

Introduction into principles and techniques used in modern microwave circuit design.

BE2M37DTRA	Digital Audio and Video Broadcasting	Z,ZK	6

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.

BE2M17MIMA	Microwave Measurements	Z,ZK	6

Fast development of wireless radio data communications (both mobile and stationary) also results in requirements for measurement of numerous related electrical parameters in frequency band ranging from hundreds of MHz to tens of GHz. The "Microwave measurements" subject brings description of all important measurement instruments and measurement methods used in this field. Instructions devoted to measurement devices also cover detailed inner structures, principles of operation, common measurement setups and optimum setting. Even relatively complex measurement instruments and setups are discussed, for example those used for measurement of noise and non-linear parameters. Exercises are focused on practical measurements commonly performed in the wireless communication field. Besides modern measurement instruments, students also learn a number of typical RF and microwave components, circuits, subsystems and digitally modulated signals.

BE2M32MKSA	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.

BE2M37RNVA	Radio Navigation	Z,ZK	6

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.

BE2M34NSV	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.

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

Code of the group: 2018_MEKEVOL
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: ~Student can choose arbitrary subject of themagister's program (EEM - Electrical Engineering, Power Engineering and Management, EK - Electronics and Communications, KYR - Cybernetics and Robotics, OI - Open Informatics, OES - Open Electronics Systems) which is not part of his curriculum. Student can choose with consideration of recommendation of the branch guarantee.You can find a selection of optional courses organized by the departments on the web site http://www.fel.cvut.cz/cz/education/volitelne-predmety.html

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Code of the group: 2018_MEKEH
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**
AE0M32KMP	**Communications and Media Law**	Z,ZK	4	2P + 2C	Z,L	V
BE0M16HSD	**History of economy and social studies** *Marcela Efmertová* ***Marcela Efmertová*** *Marcela Efmertová (Gar.)*	Z,ZK	4	2P+2S	Z,L	V
BE0M16HT2	**History of science and technology 2** ***Marcela Efmertová***	Z,ZK	4	2P+2S	L	V
BE0M16FI2	**Philosophy II**	Z,ZK	4	2P+2S	L	V
BE0M16MPS	**Psychology**	Z,ZK	4	2P+2S	L	V
BE0M16TE1	**Theology**	Z,ZK	4	2P+2S	L	V

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

AE0M32KMP	Communications and Media Law	Z,ZK	4
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.			
BE0M16HSD	History of economy and social studies	Z,ZK	4
This subject deals with the history of the European and Czech society in the 19th - 21th centuries. It follows the forming of the European and Czech political representation, its aims and achieved results as well as the social, economical, technical and cultural development and coexistence of the various ethnical groups.			
BE0M16HT2	History of science and technology 2	Z,ZK	4
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			
BE0M16FI2	Philosophy II	Z,ZK	4
The course is oriented on the transdisciplinar aspects of philosophy, informatics, physics, mathematics and biology.			
BE0M16MPS	Psychology	Z,ZK	4
BE0M16TE1	Theology	Z,ZK	4
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.			

List of courses of this pass:

Code	Name of the course	Completion	Credits
AE0M32KMP	Communications and Media Law	Z,ZK	4
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.			
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.			
BE0M16FI2	Philosophy II	Z,ZK	4
The course is oriented on the transdisciplinar aspects of philosophy, informatics, physics, mathematics and biology.			
BE0M16HSD	History of economy and social studies	Z,ZK	4
This subject deals with the history of the European and Czech society in the 19th - 21th centuries. It follows the forming of the European and Czech political representation, its aims and achieved results as well as the social, economical, technical and cultural development and coexistence of the various ethnical groups.			
BE0M16HT2	History of science and technology 2	Z,ZK	4
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			
BE0M16MPS	Psychology	Z,ZK	4
BE0M16TE1	Theology	Z,ZK	4
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.			
BE2M17ANT	Antennas	Z,ZK	6
Student will get strong knowledge about theory of electromagnetic field radiation and basic principles of antenna design. Methods of analysis are demonstrated on various types of antennas and their arrays. Seminars are both theoretical (analytical and numerical calculation using MATLAB and EM simulators CST) and practical (measurement of antenna parameters).			
BE2M17CADA	CAD in HF Technique	Z,ZK	6
Introduction into principles and techniques used in modern microwave circuit design.			
BE2M17MIMA	Microwave Measurements	Z,ZK	6
Fast development of wireless radio data communications (both mobile and stationary) also results in requirements for measurement of numerous related electrical parameters in frequency band ranging from hundreds of MHz to tens of GHz. The "Microwave measurements" subject brings description of all important measurement instruments and measurement methods used in this field. Instructions devoted to measurement devices also cover detailed inner structures, principles of operation, common measurement setups and optimum setting. Even relatively complex measurement instruments and setups are discussed, for example those used for measurement of noise and non-linear parameters. Exercises are focused on practical measurements commonly performed in the wireless communication field. Besides modern measurement instruments, students also learn a number of typical RF and microwave components, circuits, subsystems and digitally modulated signals.			
BE2M17MIOA	Microwave Circuits	Z,ZK	6
Subject is focused on the design of planar passive and active microwave circuits.			
BE2M17SBS	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.			
BE2M31DSPA	Digital Signal Processing	Z,ZK	6
The subject gives overview about basic methods of digital signal processing and their applications (examples from speech and biological signal processing): disrete-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 http://noel.feld.cvut.cz/vyu/be2m31dspa .		
BE2M32BTSA	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.		
BE2M32MKSA	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.		
BE2M34NSV	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.		
BE2M37ART	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.		
BE2M37DKM	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.		
BE2M37DTRA	Digital Audio and Video Broadcasting	Z,ZK	6
	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.		
BE2M37MAM	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.		
BE2M37RNVA	Radio Navigation	Z,ZK	6
	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.		
BE2MPROJ6	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. List of possible topics: http://www.fel.cvut.cz/en/education/semestral-projects.html		

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