

# Study plan

## Name of study plan: Cybernetics and Robotics 2016

Faculty/Institute/Others: Faculty of Electrical Engineering

Department:

Branch of study guaranteed by the department: Common courses

Garantor of the study branch:

Program of study: Cybernetics and Robotics

Type of study: Bachelor full-time

Required credits: 174

Elective courses credits: 6

Sum of credits in the plan: 180

Note on the plan:

Name of the block: Compulsory courses in the program

Minimal number of credits of the block: 158

The role of the block: P

Code of the group: 2021\_BKYRBAP

Name of the group: Bachelor Project

Requirement credits in the group: In this group you have to gain 20 credits

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

Credits in the group: 20

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
BBAP20	<b>Bachelor thesis</b> Roman Mejla Roman Mejla (Gar.)	Z	20	12S	L,Z	P

### Characteristics of the courses of this group of Study Plan: Code=2021\_BKYRBAP Name=Bachelor Project

BBAP20	Bachelor thesis	Z	20
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Code of the group: 2021\_BKYRBBE

Name of the group: Safety of the bachelor's studies

Requirement credits in the group:

Requirement courses in the group: In this group you have to complete at least 2 courses

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
BEZB	<b>Safety in Electrical Engineering for a bachelor's degree</b> Ivana Nová, Radek Havlí ek, Vladimír K la Radek Havlí ek Vladimír K la (Gar.)	Z	0	2BP+2BC	Z,L	P
BEZZ	<b>Basic health and occupational safety regulations</b> Ivana Nová, Radek Havlí ek, Vladimír K la Radek Havlí ek Vladimír K la (Gar.)	Z	0	2BP+2BC	Z	P

### Characteristics of the courses of this group of Study Plan: Code=2021\_BKYRBBE Name=Safety of the bachelor's studies

BEZB	Safety in Electrical Engineering for a bachelor's degree	Z	0
The purpose of the safety course is to give the students basic knowledge of electrical equipment and installation as to avoid danger arising from operation of it. This introductory course contains fundamentals of Safety Electrical Engineering. In this way the students receive qualification of instructed person that enables them to work on electrical equipment.			
BEZZ	Basic health and occupational safety regulations	Z	0
The guidelines were worked out based on The Training Scheme for Health and Occupational Safety designed for employees and students of the Czech Technical University in Prague, which was provided by the Rector's Office of the CTU. Safety is considered one of the basic duties of all employees and students. The knowledge of Health and Occupational Safety regulations forms an integral and permanent part of qualification requirements. This program is obligatory.			

Code of the group: 2021\_BKYRH

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
B0B16ET1	<b>Ethic 1</b> Vladimír Sláma ka Vladimír Sláma ka Vladimír Sláma ka (Gar.)	KZ	4	2P+2C	Z	P
B0B16FIL	<b>Philosophy</b> Peter Zamarovský Peter Zamarovský Peter Zamarovský (Gar.)	ZK	2	2P+0S	Z,L	P
B0B16F11	<b>Philosophy 1</b> Peter Zamarovský Peter Zamarovský Peter Zamarovský (Gar.)	KZ	4	2P+2S	Z	P
B0B16HTE	<b>History of technology and economic</b> Marcela Efmertová, Jan Mikeš Marcela Efmertová Marcela Efmertová (Gar.)	ZK	2	2P+0S	Z,L	P
B0B16HT1	<b>History of science and technology 1</b> Marcela Efmertová, Jan Mikeš Marcela Efmertová Marcela Efmertová (Gar.)	KZ	4	2P+2S	Z	P
B0B16HI1	<b>History 1</b> Milena Josefovi ová Milena Josefovi ová Milena Josefovi ová (Gar.)	KZ	4	2P+2S	Z	P
B0B16MPS	<b>Psychology</b> Jan Fiala Jan Fiala Jan Fiala (Gar.)	Z,ZK	4	2P+2S	Z,L	P
B0B16MPL	<b>Psychology for managers</b> Jan Fiala Jan Fiala Jan Fiala (Gar.)	ZK	2	2P+0S	Z,L	P
A003TV	<b>Physical Education</b>	Z	2	0+2	L,Z	P

**Characteristics of the courses of this group of Study Plan: Code=2021\_BKYRH Name=Humanities subjects**

B0B16ET1	Ethic 1	KZ	4	Aim of this subject is to provide the students an orientation not only in general problems of ethics but above all to offer instructions for solving various situations of human life. Essential parts of the subject are discussions in which students can react to lectures but also to actual questions coming with news and look for the communal answers.		
B0B16FIL	Philosophy	ZK	2	We deal with the most important persons, schools and ideas of ancient philosophy. We are concerned especially on transdisciplinary nature of philosophy and connection of old philosophical thoughts with recent problems of science, technology, economics and politics.		
B0B16F11	Philosophy 1	KZ	4	We deal with the most important persons, schools and ideas of ancient philosophy. We are concerned especially on transdisciplinary nature of philosophy and connection of old philosophical thoughts with recent problems of science, technology, economics and politics.		
B0B16HTE	History of technology and economic	ZK	2			
B0B16HT1	History of science and technology 1	KZ	4			
B0B16HI1	History 1	KZ	4			
B0B16MPS	Psychology	Z,ZK	4			
B0B16MPL	Psychology for managers	ZK	2			
A003TV	Physical Education	Z	2			

Code of the group: 2021\_BKYRP

Name of the group: Compulsory subjects of the programme

Requirement credits in the group: In this group you have to gain 138 credits

Requirement courses in the group: In this group you have to complete 24 courses

Credits in the group: 138

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
B3B33ALP	<b>Algorithms and programming</b> Jan Kybic Jan Kybic Jan Kybic (Gar.)	Z,ZK	6	2P+2C	Z	P
B3B35ARI1	<b>Automatic Control</b> Michael Šebek, Tomáš Haniš, Martin Hromík Tomáš Haniš Michael Šebek (Gar.)	Z,ZK	6	4P+2L	L	P
B0B01DRN	<b>Differential Equations and Numerical Analysis</b> Petr Habala, Daniel Gromada, Josef Dvořák, Karel Pospíšil Petr Habala (Gar.)	Z,ZK	4	2P+2C	L	P
B3B31EPO	<b>Electronic devices and circuits</b> Jiří Hospodka, Jan Havlík Jiří Hospodka Jiří Hospodka (Gar.)	Z,ZK	6	4P+2L	Z	P
B3B02FY1A	<b>Physics 1</b> Michal Bednařík Michal Bednařík Michal Bednařík (Gar.)	Z,ZK	7	4P+1L+2C	L	P

B3B02FY2	<b>Physics 2</b> <i>Michal Bedna ěk Michal Bedna ěk Michal Bedna ěk (Gar.)</i>	Z,ZK	6	3P+1L+2C	Z	P
B3B35HSS	<b>Humanitní, um lecký a spole enskov dní seminá</b> <i>Michael Šebek</i>	Z	4	40S	L	P
B3B01KAT1	<b>Complex Analysis and Transformations</b> <i>Jan Hamhalter, Josef Tkadlec Jan Hamhalter Jan Hamhalter (Gar.)</i>	Z,ZK	6	4P+2S	Z	P
B3B38KDS1	<b>Communication and Distributed Systems</b>	Z,ZK	6	4P+2L	Z	P
B3B33KUI	<b>Cybernetics and Artificial Intelligence</b> <i>Tomáš Svoboda, Petr Pošík Tomáš Svoboda Tomáš Svoboda (Gar.)</i>	Z,ZK	6	2P+2C	L	P
B0B01LAG	<b>Linear Algebra</b> <i>Daniel Gromada, Josef Dvo ák, Ji í Velebil, Mat j Dostál Ji í Velebil Ji í Velebil (Gar.)</i>	Z,ZK	8	4P+2S	Z	P
B0B35LSP	<b>Logic systems and processors</b> <i>Richard Šusta, Martin Hlinovský Martin Hlinovský Zden k Hurák (Gar.)</i>	Z,ZK	6	2P+2L	L	P
B0B01LGR	<b>Logic and Graphs</b> <i>Mat j Dostál, Alena Gollová, Natalie Žukovec Mat j Dostál Marie Demlová (Gar.)</i>	Z,ZK	5	3P+2S	Z,L	P
B0B01MA1	<b>Mathematical Analysis 1</b> <i>Josef Dvo ák, Karel Pospíšil, Josef Tkadlec, Martin K epela Josef Tkadlec Josef Tkadlec (Gar.)</i>	Z,ZK	7	4P+2S	Z,L	P
B0B01MA2	<b>Mathematical Analysis 2</b> <i>Karel Pospíšil, Natalie Žukovec, Martin K epela, Petr Hájek, Martin Bohata, Jaroslav Tišer, Miroslav Korbela , Zden k Mihula, Paola Vivi Martin Bohata Jaroslav Tišer (Gar.)</i>	Z,ZK	7	4P+2S	L,Z	P
B0B33OPT	<b>Optimization</b> <i>Tomáš Werner, Petr Olšák, Mirko Navara, Tomáš Kroupa Tomáš Kroupa Tomáš Werner (Gar.)</i>	Z,ZK	7	4P+2C	Z,L	P
B0B01PST1	<b>Probability and Statistics</b> <i>Kate ina Helisová Kate ina Helisová Petr Hájek (Gar.)</i>	Z,ZK	6	4P+2S	Z	P
B3B04PRE	<i>Jitka Pinková, Dana Saláková Jitka Pinková</i>	KZ	2	2C	L	P
B3B36PRG	<b>Programming in C</b> <i>Jan Faigl Jan Faigl Jan Faigl (Gar.)</i>	Z,ZK	6	2P+2C	L	P
B3BPROJ5	<b>Bachelor project</b> <i>Petr Pošík, Martin Hlinovský, Tomáš Drábek, Kamila Krupková, Drahomíra Hejtmanová, Šárka Hejtmanová, Jana Zichová Martin Hlinovský Martin Hlinovský (Gar.)</i>	Z	5	4s	Z	P
B3B35RO1	<b>Robots</b> <i>Martin Hlinovský, Vojt ch Petrucha, Pavel Krsek, Mat j Št tka Vojt ch Petrucha Martin Hlinovský (Gar.)</i>	KZ	4	1P+3L	Z	P
B3B33ROB1	<b>Robotics</b>	Z,ZK	6	2P+2L	Z	P
B3B38SME1	<b>Sensors and Measurement</b> <i>Vojt ch Petrucha, Pavel Ripka Vojt ch Petrucha Vojt ch Petrucha (Gar.)</i>	Z,ZK	6	3P+2L	L	P
B3B31SSI	<b>Signals, systems and inference</b> <i>Radoslav Bortel Radoslav Bortel Radoslav Bortel (Gar.)</i>	Z,ZK	6	4P+2C	Z	P

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

B3B33ALP	Algorithms and programming	Z,ZK	6
This subject will give students a basic understanding of algorithms and programming and teach them to design, implement and test algorithms for simple tasks. The students will understand the notion of computational complexity. They will learn about basic program building blocks such as loops, conditional statements, variables, functions and recursion. We will introduce the most often used data structures (queue, stack, list, array etc) and operations on them. We will show the basic algorithms, for example for searching and sorting. Students will learn to write simple programs in Python.			
B3B35ARI1	Automatic Control	Z,ZK	6
Foundation course of automatic control. Introduction to basic concepts and properties of dynamic systems of physical, engineering, biological, economics, robotics and informatics nature. Basic principles of feedback and its use as a tool for altering the behavior of systems and managing uncertainty. Classical and modern methods for analysis and design of automatic control systems. Students specialized in systems and control will build on these ideas and knowledge in the advanced courses to follow. Students of other branches and programs will find out that control is an inspiring, ubiquitous and entertaining field worth of a future cooperation. Students' creativity is developed in our laboratories.			
B0B01DRN	Differential Equations and Numerical Analysis	Z,ZK	4
This course introduces students to the classical theory of ordinary differential equations (separable and linear ODEs) and also to basics of numerical methods (errors in calculations and stability, numerical solutions of algebraic and differential equations and their systems). The course takes advantage of the synergy between theoretical and practical point of view.			
B3B31EPO	Electronic devices and circuits	Z,ZK	6
The course introduces students to the basic principles and methods of analysis of electrical circuits. Defines the circuit elements and gives their elementary application. It deals with the basic fundamentals of electronic systems based on analog as well as digital circuits. The course presents operational principles and methods of analysis of these circuits with respect to the use of cybernetics and control systems.			
B3B02FY1A	Physics 1	Z,ZK	7
The basic course of physics at the Faculty of Electrical Engineering - Physics 1, is devoted to the introduction into two important areas of physics. The first one is a classical mechanics and the second one is the electric and magnetic field. Within the framework of the classical mechanics, the students study the particle kinematics; dynamics of the mass particle, system of mass particles and rigid bodies. The students should be able to solve basic problems dealing with the description of mechanical systems, which they can meet during their further studies. The classical mechanics is followed by the relativistic mechanics, electric and magnetic field - both stationary as well as non-stationary. The students can use the facts gained in this course in the study of electrical circuits, theory of electrotechnical materials or radioelectronics. Apart of this, the knowledge gained in this course is required for the study of the consecutive course Physics 2.			
B3B02FY2	Physics 2	Z,ZK	6
The course Physics 2 is closely linked with the course Physics 1. Within the framework of this course the students will first of all learn foundations of thermodynamics. Following topic - the theory of waves - will give to the students basic insight into the properties of waves and will help to the students to understand that the presented description of the waves has a universal character in spite of the waves character. Particular types of waves, such as acoustic or optical waves are the subjects of the following section. Quantum mechanics and nuclear physics will complete the student's general education in physics. The knowledge gained in this course will help to the students in study of such modern areas as robotics, computer vision, measuring technique and will allow them to understand the principles of novel technologies and functioning of new electronic devices.			

B3B35HSS	Humanitní, um lecký a spole enskov dní seminář	Z	4
B3B01KAT1	Complex Analysis and Transformations	Z,ZK	6
B3B38KDS1	Communication and Distributed Systems	Z,ZK	6
<p>The course is devoted to the principles of communication in distributed systems (DS), both in common computer networks and in specialized networks for industrial control and in networks for the Internet of Things. 1. Introduction, basic concepts, ISO / OSI model 2. Systems with distributed parameters, physical channel (metallic, optical and radio) and its properties 3. Communication channel models (AWGN, BSC...), narrowband analog and digital modulation 4. Entropy of information source, source and channel coding, channel capacity 5. Codes for error detection and correction (groups and solids, linear and cyclic codes) 6. Information confidentiality, symmetric and asymmetric encryption, key distribution, certificates, digital signature 7. Types of data transmissions, multiplexing, methods of access control to shared media 8. Physical and logical topologies, ARQ methods, heterogeneous distributed systems 9. Industrial distributed systems (IDS), virtual field device, object directory... 10. Functional principles of IDS, typical applications and their solutions 11. Computer and LAN networks, functional principles, implementation of real-time functions, time synchronization 12. Wireless LANs and Internet of Things networks 13. TCP / IP family protocols, IP protocol, ARP, DHCP, ICMP, NAT, 14. Transport protocols of the TCP / IP, UDP, TCP, RTP family, data flow control, congestion control Laboratory exercises will be focused on the practical acquisition of theoretical knowledge. They will require home preparation in the form of self-study, subsequent elaboration of a protocol evaluating the measured or otherwise obtained results, their agreement with theoretical assumptions and justifying any differences. The credit project will focus on the practical implementation of data transmission with defined properties in the IP network environment.</p>			
B3B33KUI	Cybernetics and Artificial Intelligence	Z,ZK	6
<p>The course introduces the students into the field of artificial intelligence and gives the necessary basis for designing machine control algorithms. It advances the knowledge of state space search algorithms by including uncertainty in state transition. Students are introduced into reinforcement learning for solving problems when the state transitions are unknown, which also connects the artificial intelligence and cybernetics fields. Bayesian decision task introduces supervised learning. Learning from data is demonstrated on a linear classifier. Students practice the algorithms in computer labs.</p>			
B0B01LAG	Linear Algebra	Z,ZK	8
<p>The course covers the initial parts of linear algebra. Firstly, the basic notions of a linear space and linear mappings are covered (linear dependence and independence, basis, coordinates, etc). The calculus of matrices (determinants, inverse matrices, matrices of a linear map, eigenvalues and eigenvectors, diagonalisation, etc) is covered next. The applications include solving systems of linear equations, the geometry of a 3D space (including the scalar product and the vector product) and SVD.</p>			
B0B35LSP	Logic systems and processors	Z,ZK	6
<p>The course is an introduction to basic hardware structures of computing resources, their design, and architecture. It provides an overview of the implementation of data operations at hardware and the creation of embedded processor systems with peripherals on advance programmable logic FPGAs.</p>			
B0B01LGR	Logic and Graphs	Z,ZK	5
<p>This course covers basics of mathematical logic and graph theory. Syntax and semantics of propositional and predicate logic are introduced. The importance of the notion of semantic consequence and of the relationship between a formula and its model is stressed. Further, basic notions from graph theory are introduced.</p>			
B0B01MA1	Mathematical Analysis 1	Z,ZK	7
<p>The aim of the course is to introduce students to basics of differential and integral calculus of functions of one variable.</p>			
B0B01MA2	Mathematical Analysis 2	Z,ZK	7
<p>The subject covers an introduction to the differential and integral calculus in several variables and basic relations between curve and surface integrals. Other part contains function series and power series with application to Taylor and Fourier series.</p>			
B0B33OPT	Optimization	Z,ZK	7
<p>The course provides an introduction to mathematical optimization, specifically to optimization in real vector spaces of finite dimension. The theory is illustrated with a number of examples. The education focuses on the ability to formulate, analyze and assess the complexity of optimization problems.</p>			
B0B01PST1	Probability and Statistics	Z,ZK	6
<p>Basics of probability theory and mathematical statistics. Includes descriptions of probability, random variables and their distributions, characteristics and operations with random variables. Basics of mathematical statistics: Point and interval estimates, methods of parameters estimation and hypotheses testing, least squares method. Basic notions and results of the theory of Markov chains.</p>			
B3B04PRE		KZ	2
B3B36PRG	Programming in C	Z,ZK	6
<p>The course targets to gain a deep, comprehensive knowledge of the C programming language in terms of program operation, access and memory management, and the development of multi-threaded applications. The course emphasizes acquiring programming habits for creating readable and reusable programs. Students get acquainted with the compilation of the source codes and their debugging. Lectures are based on the presentation of basic software constructs and demonstration of motivational programs with practical constructs pointing to the readability and structure of source code, real computational complexity, and related tools for profiling and debugging. Students get acquainted with the principles of parallel programming of multi-threaded applications, synchronization mechanisms, and models of multi-threaded applications. At the end of the semester, the basic features of the object-oriented C ++ extension are briefly presented.</p>			
B3BPROJ5	Bachelor project	Z	5
B3B35RO1	Robots	KZ	4
B3B33ROB1	Robotics	Z,ZK	6
<p>The course is an introduction into industrial robotics with the emphasis on the industrial robots and manipulators. The robot kinematics is thoroughly studied. The student shall be able to choose, design, and program industrial robot and integrate it into the robotic cell after passing the course.</p>			
B3B38SME1	Sensors and Measurement	Z,ZK	6
<p>1. Sampling, D / A and A / D converters, digital oscilloscope 2. Measurement of voltage and current (digital voltmeter and multimeter, analog measuring instruments) measurement of frequency and phase difference, error and uncertainty, Measurement of effective value, power and energy consumption 3. Resistance measurement, resistance temperature and deformation sensors. Low voltage measurement, thermocouple temperature measurement 4. Magnetic sensors, magnetic measurements, voltage and current transformer Sensors el. Proudou. Impedance measurement 5 Capacitive and inductive sensors Measurement of linear and angular position - magnetic and optoelectronic sensors 6. sensors for measuring speed and speed, sensors and transducers for measuring acceleration. Vibration measurement 7 Temperature measurement by contact sensors 8. Non-contact temperature measurement 9. Measurement of force and pressure. Level measurement 10. Flow and level measurement 11. Measuring systems, sensor buses. Logic analyzer 12. Other measuring instruments, standards of electrical quantities 13. Chemical sensors 14. Repetition, solution of test examples</p>			
B3B31SSI	Signals, systems and inference	Z,ZK	6

Code of the group: 2021\_BZAJ

Name of the group: Exam from the english language

Requirement credits in the group:

Requirement courses in the group: In this group you have to complete 2 courses

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
B0B04B1K	<b>English language B1 - classified assessment</b> Dana Saláková, Petra Jennings, Markéta Havlíková, Pavla Péterová, Erik Peter Stadnik, Michael Ynsua <b>Petra Jennings</b> Dana Saláková (Gar.)	KZ	0	0C	Z,L	P
B0B04B2Z	<b>English language B2 - exam</b> Dana Saláková, Petra Jennings, Markéta Havlíková, Pavla Péterová, Erik Peter Stadnik, Michael Ynsua <b>Petra Jennings</b> Dana Saláková (Gar.)	Z,ZK	0	0C	Z,L	P

**Characteristics of the courses of this group of Study Plan: Code=2021\_BZAJ Name=Exam from the english language**

B0B04B1K	English language B1 - classified assessment verifying of the student's skills of B1 level	KZ	0			
B0B04B2Z	English language B2 - exam I) The B2 English Exam is a compulsory subject for all Faculty of Electrical Engineering students at the Czech Technical University. According to the Study and Examination Rules and Regulations for Students at CTU (Part III, Article 4), a compulsory subject is one "whose completion is a necessary condition in order to successfully complete the study programme." In addition, this requires the "passing of an examination evaluated on the scale A, B, C, D, or E..." (SERR Part III, Article 6). II) According to the Common European Framework of Reference for Languages (CEFR), an international standard for describing language ability, the definition of an English language learner who has achieved the B2 (Upper-Intermediate) level is one who "...can understand the main ideas of complex text on both concrete and abstract topics, including technical discussions in his/her field of specialisation. Can interact with a degree of fluency and spontaneity that makes regular interaction with native speakers quite possible without strain for either party. Can produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options." III) Students who have successfully passed an approved international exam within the past five years may present their certificate to the Department of Languages, Faculty of Electrical Engineering. Upon approval, students are then exempt from both the Written Test and the Oral Part. For a list of approved international exams go the department website: <a href="http://jazyky.fel.cvut.cz/">http://jazyky.fel.cvut.cz/</a>	Z,ZK	0			

Name of the block: Compulsory elective courses

Minimal number of credits of the block: 16

The role of the block: PV

Code of the group: 2021\_BKYRPV

Name of the group: Compulsory subjects of the programme

Requirement credits in the group: In this group you have to gain at least 12 credits (at most 30)

Requirement courses in the group: In this group you have to complete at least 2 courses ( at most 5)

Credits in the group: 12

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
B2M37DKM	<b>Digital communications</b> Jan Sýkora <b>Jan Sýkora</b> Jan Sýkora (Gar.)	Z,ZK	6	3P+1C	Z	PV
B3B14EPR1	<b>Electric Drives for Automation and Robotics</b>	Z,ZK	6	2P+2L	L	PV
B3B35JVC	<b>Jak vyrobit (tém ) cokoli</b> Ji í Zemánek <b>Ji í Zemánek</b> Ji í Zemánek (Gar.)	KZ	6	2P+4L	L	PV
B3B35MSD1	<b>Modeling and simulation of dynamic systems</b> Ji í Zemánek	Z,ZK	6	2P+2C	Z	PV
B3B38OTE1	<b>Circuit Technologies</b> Jan Holub <b>Jan Holub</b> Jan Holub (Gar.)	Z,ZK	6	2P+2L	L	PV
B0B01PAN	<b>Advanced Analysis</b> Jan Hamhalter, Veronika Sobotíková <b>Veronika Sobotíková</b> Jan Hamhalter (Gar.)	Z,ZK	6	2P+2S	L	PV
B3B35PAR1	<b>Programming of logic controllers and robots</b> Martin Hlinovský, Pavel Burget <b>Pavel Burget</b> Pavel Burget (Gar.)	Z,ZK	6	1P+3L	L	PV
B3B33UROB	<b>Robot Learning</b>	Z,ZK	6	2P+2C	Z	PV
B3B38VSY1	<b>Embedded Systems</b> Jan Fischer <b>Jan Fischer</b> Jan Fischer (Gar.)	Z,ZK	6	2P+2L	Z	PV

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

B2M37DKM	Digital communications 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.	Z,ZK	6			
B3B14EPR1	Electric Drives for Automation and Robotics The aim of the course is to understand the basic principles of rotating machines, to gain an overview of their properties and capabilities, control methods, including respecting the influence of the load on the drive. The course provides a brief overview of the basic types of electric drives. It deals with drives that are used as servo drives, ie DC, asynchronous, synchronous with permanent magnets and marginally special motors. The course discusses the topologies of power electronic converters, including basic modulation strategies and strategies for the control of servo drives such as vector, direct, MTPA control with emphasis on today's most commonly used PMSM motors. The course is focused not only on understanding the physical nature of the type of drive, but also on understanding the principles of operation of other important components such as sensors, semiconductor converters and digital controllers themselves. It also includes a description of the interaction of the drive with the inertial mass of the load in servomechanisms and other typical types of load in general.	Z,ZK	6			
B3B35JVC	Jak vyrobit (tém ) cokoli	KZ	6			

B3B35MSD1	Modeling and simulation of dynamic systems	Z,ZK	6
B3B38OTE1	Circuit Technologies	Z,ZK	6
Students will get acquainted with the basic types of circuits and structural blocks of digital instruments and equipment. Emphasis is placed on the continuity of individual circuits in terms of accuracy in analog or analog-to-digital circuits. 1. Structure of digital measuring instruments and signal generators 2. Directly coupled amplifiers and attenuators 3. Isolation and modulation amplifiers 4. Circuits for conversion of mean and rms value, peak detectors 5. Circuits for frequency signal conditioning, oscillators, mixers 6. Reference voltage and current sources, sine and function generators 7. Design of strings and channels of analog blocks - signal levels, linearity, interference 8. Switching and coupling circuits 9. Time and amplitude discretization of signal, samplers, errors 10. Advanced analog-to-digital converters 11. Digital-to-analog converters, signal reconstruction 12. Digital circuits for frequency and phase measurement, phase synchronization, direct digital synthesis 13. Circuits for the implementation of interfaces for connection to buses 14. Design of analog and digital part in terms of self-radiation and resistance to interference The laboratory exercises of the first part of the semester take place on suitable universal preparations, enabling students to work with HW in an efficient and at the same time creative way. In the second part of the semester, laboratory exercises will be solved in the form of an individual project, the content of which is the design and implementation of a model of an analog signal preprocessing block and comparison of its properties with a professional product.			
B0B01PAN	Advanced Analysis	Z,ZK	6
Subject serves as an introduction to measure and integration theory and functional analysis. The first part deals with Lebesgue integration theory. Next parts are devoted to basic concepts of the theory of Banach and Hilbert spaces and their connection to harmonic analysis. Last part deals with spectral theory of operators and their application to matrix analysis.			
B3B35PAR1	Programming of logic controllers and robots	Z,ZK	6
B3B33UROB	Robot Learning	Z,ZK	6
The course teaches application of machine learning methods and optimization on well-known robotic problems, such as semantic segmentation from RGB-D data or reactive motion control. The core of the course represents teaching of deep learning methods. Students will use basic knowledge from optimization and linear algebra such as robot solving of overdetermined systems of (non)linear (non)homogenous equations or gradient minimization methods. The labs are divided into two parts, in the first one, the students will solve basic tasks in PyTorch, in the second one, individual semestral work.			
B3B38VSY1	Embedded Systems	Z,ZK	6
The course is focused on the means, components and solutions of embedded systems, with microcontrollers with ARM Cortex-M core. After introductory tasks within the lab. students solve two smaller and two larger vest projects. system with a microcontroller and other electronic blocks on a solderless contact field. Projects include program and circuit implementation.			

Code of the group: 2021\_BKYRLAB

Name of the group: Compulsory subjects of the programme

Requirement credits in the group: In this group you have to gain at least 4 credits (at most 12)

Requirement courses in the group: In this group you have to complete at least 1 course ( at most 3)

Credits in the group: 4

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
B3B35LAR	Laboratory of applied electronics and control Martin Hlinovský Martin Hlinovský (Gar.)	KZ	4	0P+4L	L	PV
B3B38LPE1	Laboratories of Industrial Electronics Tomáš Drábek, Vojt ch Petrucha, Jan Fischer, Michal Janošek Vojt ch Petrucha Vojt ch Petrucha (Gar.)	KZ	4	0P+4L	L	PV
B3B33LAR	Laboratory of robotics Pavel Krsek, Vladimír Petřík, Libor Wagner Pavel Krsek Pavel Krsek (Gar.)	KZ	4	0P+4L	L	PV

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

B3B35LAR	Laboratory of applied electronics and control	KZ	4
B3B38LPE1	Laboratories of Industrial Electronics	KZ	4
B3B33LAR	Laboratory of robotics	KZ	4

During this laboratory courses the students are introduced with the practical robotics through solving of practical tasks. Students are working in laboratories in groups which consist of 3 or 4 members. During the semester, each group of students jointly solve one practical problem in the field of robotics. Tasks are designed to introduce students with robotics (manipulators and mobile robots). The students should utilize the basic knowledge obtained in previous study (eg. mathematics, physics, electronics, software development). Students can select specific task from few tasks with different specialization, which are announced each semester. Tasks differs between semesters. An integral part of the solution of the problem is cooperation and communication in the student team.

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\_BJKA

Name of the group: English language courses

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) <i>Tutors, authors and guarantors (gar.)</i>	Completion	Credits	Scope	Semester	Role
B0B04A21	<b>English Language A2-1</b> <i>Dana Saláková</i>	Z		2s	Z	v
B0B04A22	<b>English Language A2-2</b> <i>Dana Saláková</i>	Z	0	2s	L	v
B0B04B11	<b>English Language B1-1</b> <i>Petra Jennings Dana Saláková (Gar.)</i>	Z	0	2C	Z	v
B0B04B12	<b>English Language B1-2</b> <i>Markéta Havlíková Dana Saláková (Gar.)</i>	Z	0	2C	L	v
B0B04B21	<b>English Language B2-1</b> <i>Petra Jennings Dana Saláková (Gar.)</i>	Z	3	2C	Z	v
B0B04B22	<b>English Language B2-2</b> <i>Petra Jennings Dana Saláková (Gar.)</i>	Z	3	2C	Z,L	v

**Characteristics of the courses of this group of Study Plan: Code=2021\_BJKA Name=English language courses**

B0B04A21	English Language A2-1	Z				
The course is open to students who are beginners in their second language. Course objective: Achieving competence in basic English.						
B0B04A22	English Language A2-2	Z	0			
The course is open to students who are beginners in their second foreign language. The course objective is to develop and sustain their basic knowledge of the English language.						
B0B04B11	English Language B1-1	Z	0			
Course objective: Broadening the basic knowledge of general English; mastering basic specialised language; focusing on text analysis and vocabulary expansion; understanding spoken English.						
B0B04B12	English Language B1-2	Z	0			
Course objective: Broadening the basic knowledge of general English; mastering basic specialised language; focusing on text analysis and vocabulary expansion; understanding spoken English.						
B0B04B21	English Language B2-1	Z	3			
This course is designed as a full-year, two semester preparation course for the university's compulsory B2-level English Examination (Anglický jazyk B2 - zkouška - B0B04B2Z*). While the course is focused on helping students reach a level required to pass the B2-level English Examination (or improve their English for a higher mark), it also focuses more on the academic and technical vocabulary and grammar expected of students at the university level. *NOTE: This exam is also used for determining an appropriate level of English for Erasmus / International Study.						
B0B04B22	English Language B2-2	Z	3			
This course is designed as a full-year, two semester preparation course for the university's compulsory B2-level English Examination (Anglický jazyk B2 - zkouška - B0B04B2Z*). While the course is focused on helping students reach a level required to pass the B2-level English Examination (or improve their English for a higher mark), it also focuses more on the academic and technical vocabulary and grammar expected of students at the university level. *NOTE: This exam is also used for determining an appropriate level of English for Erasmus / International Study.						

Code of the group: BTV

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) <i>Tutors, authors and guarantors (gar.)</i>	Completion	Credits	Scope	Semester	Role
TVV	<b>Physical education</b>	Z	0	0+2	Z,L	v
A003TV	<b>Physical Education</b>	Z	2	0+2	L,Z	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

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

A003TV	Physical Education	Z	2			
TVV	Physical education	Z	0			
TV-V1	Physical education	Z	1			
TVV0	Physical education	Z	0			

Code of the group: BTVK

Name of the group: Physical education courses

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) <i>Tutors, authors and guarantors (gar.)</i>	Completion	Credits	Scope	Semester	Role
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=BTVK Name=Physical education courses**

TVKLV	Physical Education Course	Z	0
TVKZV	Physical Education Course	Z	0

Code of the group: 2021\_BKYRVOL

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:

~Nabídka 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
B0B01DRN	Differential Equations and Numerical Analysis This course introduces students to the classical theory of ordinary differential equations (separable and linear ODEs) and also to basics of numerical methods (errors in calculations and stability, numerical solutions of algebraic and differential equations and their systems). The course takes advantage of the synergy between theoretical and practical point of view.	Z,ZK	4
B0B01LAG	Linear Algebra The course covers the initial parts of linear algebra. Firstly, the basic notions of a linear space and linear mappings are covered (linear dependence and independence, basis, coordinates, etc). The calculus of matrices (determinants, inverse matrices, matrices of a linear map, eigenvalues and eigenvectors, diagonalisation, etc) is covered next. The applications include solving systems of linear equations, the geometry of a 3D space (including the scalar product and the vector product) and SVD.	Z,ZK	8
B0B01LGR	Logic and Graphs This course covers basics of mathematical logic and graph theory. Syntax and semantics of propositional and predicate logic are introduced. The importance of the notion of semantic consequence and of the relationship between a formula and its model is stressed. Further, basic notions from graph theory are introduced.	Z,ZK	5
B0B01MA1	Mathematical Analysis 1 The aim of the course is to introduce students to basics of differential and integral calculus of functions of one variable.	Z,ZK	7
B0B01MA2	Mathematical Analysis 2 The subject covers an introduction to the differential and integral calculus in several variables and basic relations between curve and surface integrals. Other part contains function series and power series with application to Taylor and Fourier series.	Z,ZK	7
B0B01PAN	Advanced Analysis Subject serves as an introduction to measure and integration theory and functional analysis. The first part deals with Lebesgue integration theory. Next parts are devoted to basic concepts of the theory of Banach and Hilbert spaces and their connection to harmonic analysis. Last part deals with spectral theory of operators and their application to matrix analysis.	Z,ZK	6
B0B01PST1	Probability and Statistics Basics of probability theory and mathematical statistics. Includes descriptions of probability, random variables and their distributions, characteristics and operations with random variables. Basics of mathematical statistics: Point and interval estimates, methods of parameters estimation and hypotheses testing, least squares method. Basic notions and results of the theory of Markov chains.	Z,ZK	6
B0B04A21	English Language A2-1 The course is open to students who are beginners in their second language. Course objective: Achieving competence in basic English.	Z	
B0B04A22	English Language A2-2 The course is open to students who are beginners in their second foreign language. The course objective is to develop and sustain their basic knowledge of the English language.	Z	0
B0B04B11	English Language B1-1 Course objective: Broadening the basic knowledge of general English; mastering basic specialised language; focusing on text analysis and vocabulary expansion; understanding spoken English.	Z	0
B0B04B12	English Language B1-2 Course objective: Broadening the basic knowledge of general English; mastering basic specialised language; focusing on text analysis and vocabulary expansion; understanding spoken English.	Z	0
B0B04B1K	English language B1 - classified assessment verifying of the student's skills of B1 level	KZ	0
B0B04B21	English Language B2-1 This course is designed as a full-year, two semester preparation course for the university's compulsory B2-level English Examination (Anglický jazyk B2 - zkouška - B0B04B2Z*). While the course is focused on helping students reach a level required to pass the B2-level English Examination (or improve their English for a higher mark), it also focuses more on the academic and technical vocabulary and grammar expected of students at the university level. *NOTE: This exam is also used for determining an appropriate level of English for Erasmus / International Study.	Z	3



B0B04B22	English Language B2-2	Z	3
This course is designed as a full-year, two semester preparation course for the university's compulsory B2-level English Examination (Anglický jazyk B2 - zkouška - B0B04B2Z *). While the course is focused on helping students reach a level required to pass the B2-level English Examination (or improve their English for a higher mark), it also focuses more on the academic and technical vocabulary and grammar expected of students at the university level. *NOTE: This exam is also used for determining an appropriate level of English for Erasmus / International Study.			
B0B04B2Z	English language B2 - exam	Z,ZK	0
I) The B2 English Exam is a compulsory subject for all Faculty of Electrical Engineering students at the Czech Technical University. According to the Study and Examination Rules and Regulations for Students at CTU (Part III, Article 4), a compulsory subject is one "whose completion is a necessary condition in order to successfully complete the study programme." In addition, this requires the "passing of an examination evaluated on the scale A, B, C, D, or E..." (SERR Part III, Article 6). II) According to the Common European Framework of Reference for Languages (CEFR), an international standard for describing language ability, the definition of an English language learner who has achieved the B2 (Upper-Intermediate) level is one who "...can understand the main ideas of complex text on both concrete and abstract topics, including technical discussions in his/her field of specialisation. Can interact with a degree of fluency and spontaneity that makes regular interaction with native speakers quite possible without strain for either party. Can produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options." III) Students who have successfully passed an approved international exam within the past five years may present their certificate to the Department of Languages, Faculty of Electrical Engineering. Upon approval, students are then exempt from both the Written Test and the Oral Part. For a list of approved international exams go the department website: <a href="http://jazyky.fel.cvut.cz/">http://jazyky.fel.cvut.cz/</a>			
B0B16ET1	Ethic 1	KZ	4
Aim of this subject is to provide the students an orientation not only in general problems of ethics but above all to offer instructions for solving various situations of human life. Essential parts of the subject are discussions in which students can react to lectures but also to actual questions coming with news and look for the communal answers.			
B0B16F11	Philosophy 1	KZ	4
We deal with the most important persons, schools and ideas of ancient philosophy. We are concerned especially on transdisciplinary nature of philosophy and connection of old philosophical thoughts with recent problems of science, technology, economics and politics.			
B0B16FIL	Philosophy	ZK	2
We deal with the most important persons, schools and ideas of ancient philosophy. We are concerned especially on transdisciplinary nature of philosophy and connection of old philosophical thoughts with recent problems of science, technology, economics and politics.			
B0B16HI1	History 1	KZ	4
B0B16HT1	History of science and technology 1	KZ	4
B0B16HTE	History of technology and economic	ZK	2
B0B16MPL	Psychology for managers	ZK	2
B0B16MPS	Psychology	Z,ZK	4
B0B33OPT	Optimization	Z,ZK	7
The course provides an introduction to mathematical optimization, specifically to optimization in real vector spaces of finite dimension. The theory is illustrated with a number of examples. The education focuses on the ability to formulate, analyze and assess the complexity of optimization problems.			
B0B35LSP	Logic systems and processors	Z,ZK	6
The course is an introduction to basic hardware structures of computing resources, their design, and architecture. It provides an overview of the implementation of data operations at hardware and the creation of embedded processor systems with peripherals on advance programmable logic FPGAs.			
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.			
B3B01KAT1	Complex Analysis and Transformations	Z,ZK	6
B3B02FY1A	Physics 1	Z,ZK	7
The basic course of physics at the Faculty of Electrical Engineering - Physics 1, is devoted to the introduction into two important areas of physics. The first one is a classical mechanics and the second one is the electric and magnetic field. Within the framework of the classical mechanics, the students study the particle kinematics; dynamics of the mass particle, system of mass particles and rigid bodies. The students should be able to solve basic problems dealing with the description of mechanical systems, which they can meet during their further studies. The classical mechanics is followed by the relativistic mechanics, electric and magnetic field - both stationary as well as non-stationary. The students can use the facts gained in this course in the study of electrical circuits, theory of electrotechnical materials or radioelectronics. Apart of this, the knowledge gained in this course is required for the study of the consecutive course Physics 2.			
B3B02FY2	Physics 2	Z,ZK	6
The course Physics 2 is closely linked with the course Physics 1. Within the framework of this course the students will first of all learn foundations of thermodynamics. Following topic - the theory of waves - will give to the students basic insight into the properties of waves and will help to the students to understand that the presented description of the waves has a universal character in spite of the waves character. Particular types of waves, such as acoustic or optical waves are the subjects of the following section. Quantum mechanics and nuclear physics will complete the student's general education in physics. The knowledge gained in this course will help to the students in study of such modern areas as robotics, computer vision, measuring technique and will allow them to understand the principles of novel technologies and functioning of new electronic devices.			
B3B04PRE		KZ	2
B3B14EPR1	Electric Drives for Automation and Robotics	Z,ZK	6
The aim of the course is to understand the basic principles of rotating machines, to gain an overview of their properties and capabilities, control methods, including respecting the influence of the load on the drive. The course provides a brief overview of the basic types of electric drives. It deals with drives that are used as servo drives, ie DC, asynchronous, synchronous with permanent magnets and marginally special motors. The course discusses the topologies of power electronic converters, including basic modulation strategies and strategies for the control of servo drives such as vector, direct, MTPA control with emphasis on today's most commonly used PMSM motors. The course is focused not only on understanding the physical nature of the type of drive, but also on understanding the principles of operation of other important components such as sensors, semiconductor converters and digital controllers themselves. It also includes a description of the interaction of the drive with the inertial mass of the load in servomechanisms and other typical types of load in general.			
B3B31EPO	Electronic devices and circuits	Z,ZK	6
The course introduces students to the basic principles and methods of analysis of electrical circuits. Defines the circuit elements and gives their elementary application. It deals with the basic fundamentals of electronic systems based on analog as well as digital circuits. The course presents operational principles and methods of analysis of these circuits with respect to the use of cybernetics and control systems.			
B3B31SSI	Signals, systems and inference	Z,ZK	6
B3B33ALP	Algorithms and programming	Z,ZK	6
This subject will give students a basic understanding of algorithms and programming and teach them to design, implement and test algorithms for simple tasks. The students will understand the notion of computational complexity. They will learn about basic program building blocks such as loops, conditional statements, variables, functions and recursion. We			

will introduce the most often used data structures (queue, stack, list, array etc) and operations on them. We will show the basic algorithms, for example for searching and sorting. Students will learn to write simple programs in Python.			
B3B33KUI	Cybernetics and Artificial Intelligence	Z,ZK	6
The course introduces the students into the field of artificial intelligence and gives the necessary basis for designing machine control algorithms. It advances the knowledge of state space search algorithms by including uncertainty in state transition. Students are introduced into reinforcement learning for solving problems when the state transitions are unknown, which also connects the artificial intelligence and cybernetics fields. Bayesian decision task introduces supervised learning. Learning from data is demonstrated on a linear classifier. Students practice the algorithms in computer labs.			
B3B33LAR	Laboratory of robotics	KZ	4
During this laboratory courses the students are introduced with the practical robotics through solving of practical tasks. Students are working in laboratories in groups which consist of 3 or 4 members. During the semester, each group of students jointly solve one practical problem in the field of robotics. Tasks are designed to introduce students with robotics (manipulators and mobile robots). The students should utilize the basic knowledge obtained in previous study (eg. mathematics, physics, electronics, software development). Students can select specific task from few tasks with different specialization, which are announced each semester. Tasks differs between semesters. An integral part of the solution of the problem is cooperation and communication in the student team.			
B3B33ROB1	Robotics	Z,ZK	6
The course is an introduction into industrial robotics with the emphasis on the industrial robots and manipulators. The robot kinematics is thoroughly studied. The student shall be able to choose, design, and program industrial robot and integrate it into the robotic cell after passing the course.			
B3B33UROB	Robot Learning	Z,ZK	6
The course teaches application of machine learning methods and optimization on well-known robotic problems, such as semantic segmentation from RGB-D data or reactive motion control. The core of the course represents teaching of deep learning methods. Students will use basic knowledge from optimization and linear algebra such as robot solving of overdetermined systems of (non)linear (non)homogenous equations or gradient minimization methods. The labs are divided into two parts, in the first one, the students will solve basic tasks in PyTorch, in the second one, individual semestral work.			
B3B35ARI1	Automatic Control	Z,ZK	6
Foundation course of automatic control. Introduction to basic concepts and properties of dynamic systems of physical, engineering, biological, economics, robotics and informatics nature. Basic principles of feedback and its use as a tool for altering the behavior of systems and managing uncertainty. Classical and modern methods for analysis and design of automatic control systems. Students specialized in systems and control will build on these ideas and knowledge in the advanced courses to follow. Students of other branches and programs will find out that control is an inspiring, ubiquitous and entertaining field worth of a future cooperation. Students' creativity is developed in our laboratories.			
B3B35HSS	Humanitní, um lecký a spole enskov dní seminář	Z	4
B3B35JVC	Jak vyrobit (tém ) cokoli	KZ	6
B3B35LAR	Laboratory of applied electronics and control	KZ	4
B3B35MSD1	Modeling and simulation of dynamic systems	Z,ZK	6
B3B35PAR1	Programming of logic controllers and robots	Z,ZK	6
B3B35RO1	Robots	KZ	4
B3B36PRG	Programming in C	Z,ZK	6
The course targets to gain a deep, comprehensive knowledge of the C programming language in terms of program operation, access and memory management, and the development of multi-threaded applications. The course emphasizes acquiring programming habits for creating readable and reusable programs. Students get acquainted with the compilation of the source codes and their debugging. Lectures are based on the presentation of basic software constructs and demonstration of motivational programs with practical constructs pointing to the readability and structure of source code, real computational complexity, and related tools for profiling and debugging. Students get acquainted with the principles of parallel programming of multi-threaded applications, synchronization mechanisms, and models of multi-threaded applications. At the end of the semester, the basic features of the object-oriented C ++ extension are briefly presented.			
B3B38KDS1	Communication and Distributed Systems	Z,ZK	6
The course is devoted to the principles of communication in distributed systems (DS), both in common computer networks and in specialized networks for industrial control and in networks for the Internet of Things. 1. Introduction, basic concepts, ISO / OSI model 2. Systems with distributed parameters, physical channel (metallic, optical and radio) and its properties 3. Communication channel models (AWGN, BSC...), narrowband analog and digital modulation 4. Entropy of information source, source and channel coding, channel capacity 5. Codes for error detection and correction (groups and solids, linear and cyclic codes) 6. Information confidentiality, symmetric and asymmetric encryption, key distribution, certificates, digital signature 7. Types of data transmissions, multiplexing, methods of access control to shared media 8. Physical and logical topologies, ARQ methods, heterogeneous distributed systems 9. Industrial distributed systems (IDS), virtual field device, object directory... 10. Functional principles of IDS, typical applications and their solutions 11. Computer and LAN networks, functional principles, implementation of real-time functions, time synchronization 12. Wireless LANs and Internet of Things networks 13. TCP / IP family protocols, IP protocol, ARP, DHCP, ICMP, NAT, 14. Transport protocols of the TCP / IP, UDP, TCP, RTP family, data flow control, congestion control Laboratory exercises will be focused on the practical acquisition of theoretical knowledge. They will require home preparation in the form of self-study, subsequent elaboration of a protocol evaluating the measured or otherwise obtained results, their agreement with theoretical assumptions and justifying any differences. The credit project will focus on the practical implementation of data transmission with defined properties in the IP network environment.			
B3B38LPE1	Laboratories of Industrial Electronics	KZ	4
B3B38OTE1	Circuit Technologies	Z,ZK	6
Students will get acquainted with the basic types of circuits and structural blocks of digital instruments and equipment. Emphasis is placed on the continuity of individual circuits in terms of accuracy in analog or. analog-to-digital circuits. 1. Structure of digital measuring instruments and signal generators 2. Directly coupled amplifiers and attenuators 3. Isolation and modulation amplifiers 4. Circuits for conversion of mean and rms value, peak detectors 5. Circuits for frequency signal conditioning, oscillators, mixers 6. Reference voltage and current sources, sine and function generators 7. Design of strings and channels of analog blocks - signal levels, linearity, interference 8. Switching and coupling circuits 9. Time and amplitude discretization of signal, samplers, errors 10. Advanced analog-to-digital converters 11. Digital-to-analog converters, signal reconstruction 12. Digital circuits for frequency and phase measurement, phase synchronization, direct digital synthesis 13. Circuits for the implementation of interfaces for connection to buses 14. Design of analog and digital part in terms of self-radiation and resistance to interference The laboratory exercises of the first part of the semester take place on suitable universal preparations, enabling students to work with HW in an efficient and at the same time creative way. In the second part of the semester, laboratory exercises will be solved in the form of an individual project, the content of which is the design and implementation of a model of an analog signal preprocessing block and comparison of its properties with a professional product.			
B3B38SME1	Sensors and Measurement	Z,ZK	6
1. Sampling, D / A and A / D converters, digital oscilloscope 2. Measurement of voltage and current (digital voltmeter and multimeter, analog measuring instruments) measurement of frequency and phase difference, error and uncertainty, Measurement of effective value, power and energy consumption 3. Resistance measurement, resistance temperature and deformation sensors. Low voltage measurement, thermocouple temperature measurement 4. Magnetic sensors, magnetic measurements, voltage and current transformer Sensors. el. Proudou. Impedance measurement 5 Capacitive and inductive sensors Measurement of linear and angular position - magnetic and optoelectronic sensors 6. sensors for measuring speed and speed, sensors and transducers for measuring acceleration. Vibration measurement 7 Temperature measurement by contact sensors 8. Non-contact temperature measurement 9. Measurement of force and pressure. Level measurement 10. Flow and level measurement 11. Measuring systems, sensor buses. Logic analyzer 12. Other measuring instruments, standards of electrical quantities 13. Chemical sensors 14. Repetition, solution of test examples			

B3B38VSY1	Embedded Systems	Z,ZK	6
The course is focused on the means, components and solutions of embedded systems, with microcontrollers with ARM Cortex-M core. After introductory tasks within the lab. students solve two smaller and two larger vest projects. system with a microcontroller and other electronic blocks on a solderless contact field. Projects include program and circuit implementation.			
B3BPROJ5	Bachelor project	Z	5
BBAP20	Bachelor thesis	Z	20
BEZB	Safety in Electrical Engineering for a bachelor's degree	Z	0
The purpose of the safety course is to give the students basic knowledge of electrical equipment and installation as to avoid danger arising from operation of it. This introductory course contains fundamentals of Safety Electrical Engineering. In this way the students receive qualification of instructed person that enables them to work on electrical equipment.			
BEZZ	Basic health and occupational safety regulations	Z	0
The guidelines were worked out based on The Training Scheme for Health and Occupational Safety designed for employees and students of the Czech Technical University in Prague, which was provided by the Rector's Office of the CTU. Safety is considered one of the basic duties of all employees and students. The knowledge of Health and Occupational Safety regulations forms an integral and permanent part of qualification requirements. This program is obligatory.			
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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