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	**Bachelor thesis** *Roman Čmejla Roman Čmejla (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

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	**Safety in Electrical Engineering for a Bachelor´s Degree** *Ivana Nová, Radek Havlíček, Vladimír Kůla* ***Radek Havlíček*** *Vladimír Kůla (Gar.)*	Z	0	2BP+2BC	Z,L	P
BEZZ	**Basic Health and Occupational Safety Regulations** *Ivana Nová, Radek Havlíček, Vladimír Kůla* ***Radek Havlíček*** *Vladimír Kůla (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_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	**Algorithms and Programming** *Vojtěch Vonásek **Vojtěch Vonásek** Vojtěch Vonásek (Gar.)*	Z,ZK	6	2P+2C	Z	P
B3B35ARI1	**Automatic Control** *Michael Šebek, Tomáš Haniš, Martin Hromčík **Tomáš Haniš** Michael Šebek (Gar.)*	Z,ZK	6	4P+2L	L	P
B0B01DRN	**Differencial Equations and Numerical Analysis** *Petr Habala, Jakub Rondoš, Jakub Staněk, Daniel Gromada, Josef Dvořák **Petr Habala** Petr Habala (Gar.)*	Z,ZK	4	2P+2C	L	P
B3B31EPO	**Electronic Devices and Circuits** *Jiří Hospodka, Ondřej Brunner, Tomáš Kouba, Jan Havlík **Jiří Hospodka** Jiří Hospodka (Gar.)*	Z,ZK	6	4P+2L	Z	P
B3B02FY1A	**Physics 1** *Petr Koníček, Michal Bednařík **Michal Bednařík** Michal Bednařík (Gar.)*	Z,ZK	7	4P+1L+2C	L	P
B3B02FY2	**Physics 2** *Petr Koníček, Michal Bednařík, Marek Brothánek, Vojtěch Jandák **Michal Bednařík** Michal Bednařík (Gar.)*	Z,ZK	6	3P+1L+2C	Z	P
B3B35HSS	**Humanitní, umělecký a společenskovědní seminář** *Michael Šebek, Martin Hlinovský **Michael Šebek** Michael Šebek (Gar.)*	Z	4	3S	L	P
B3B01KAT1	**Complex Analysis and Transformations** *Martin Bohata, Hana Turčinová **Martin Bohata** Martin Bohata (Gar.)*	Z,ZK	6	4P+2S	Z	P
B3B38KDS1	**Communication and Distributed Systems** *Jan Holub, Jiří Novák **Jiří Novák** Jiří Novák (Gar.)*	Z,ZK	6	4P+2L	Z	P
B3B33KUI	**Cybernetics and Artificial Intelligence** *Tomáš Svoboda, Petr Pošík **Tomáš Svoboda** Tomáš Svoboda (Gar.)*	Z,ZK	6	2P+2C	L	P
B0B01LAG	**Linear Algebra** *Jakub Rondoš, Daniel Gromada, Josef Dvořák, Jiří Velebil, Natalie Žukovec, Matěj Dostál **Jiří Velebil** Jiří Velebil (Gar.)*	Z,ZK	8	4P+2S	Z	P
B0B35LSP	**Logic systems and processors** *Martin Hlinovský, Richard Šusta **Martin Hlinovský** Zdeněk Hurák (Gar.)*	Z,ZK	6	2P+2L	L	P
B0B01LGR	**Logic and Graphs** *Natalie Žukovec, Matěj Dostál, Alena Gollová **Alena Gollová** Marie Demlová (Gar.)*	Z,ZK	5	3P+2S	Z,L	P
B0B01MA1	**Mathematical Analysis 1** *Josef Dvořák, Martin Křepela, Josef Tkadlec, Veronika Sobotíková **Josef Tkadlec** Josef Tkadlec (Gar.)*	Z,ZK	7	4P+2S	Z,L	P
B0B01MA2	**Mathematical Analysis 2** *Martin Bohata, Hana Turčinová, Miroslav Korbelář, Petr Hájek, Jaroslav Tišer, Karel Pospíšil, Paola Vivi **Petr Hájek** Jaroslav Tišer (Gar.)*	Z,ZK	7	4P+2S	L,Z	P
B0B33OPT	**Optimization** *Tomáš Werner, Petr Olšák, Mirko Navara, Tomáš Kroupa **Tomáš Werner** Tomáš Werner (Gar.)*	Z,ZK	7	4P+2C	Z,L	P
B0B01PST1	**Probability and Statistics** *Kateřina Helisová **Kateřina Helisová** Petr Hájek (Gar.)*	Z,ZK	6	4P+2S	Z	P
B3B04PRE	**Presentation Skills** *Petra Juna Jennings, Jitka Pinková **Jitka Pinková** Petra Juna Jennings (Gar.)*	KZ	2	2C	L	P
B3B36PRG	**Programming in C** *Jan Faigl **Jan Faigl** Jan Faigl (Gar.)*	Z,ZK	6	2P+2C	L	P
B3BPROJ5	**Bachelor project** *Martin Hlinovský, Petr Pošík, Tomáš Drábek, Kamila Krupková, Drahomíra Hejtmanová, Šárka Hejtmanová, Jana Zichová **Martin Hlinovský** Martin Hlinovský (Gar.)*	Z	5	4s	Z	P
B3B35RO1	**Robots** *Martin Hlinovský, Vojtěch Petrucha, Pavel Krsek, Matěj Štětka **Vojtěch Petrucha** Martin Hlinovský (Gar.)*	KZ	4	1P+3L	Z	P
B3B33ROB1	**Robotics** *Vladimír Petrík **Vladimír Smutný** Vladimír Petrík (Gar.)*	Z,ZK	6	2P+2L	Z	P
B3B38SME1	**Sensors and Measurement** *Vojtěch Petrucha, Pavel Ripka **Vojtěch Petrucha** Vojtěch Petrucha (Gar.)*	Z,ZK	6	3P+2L	L	P
B3B31SSI	**Signals, systems and inference** *Radoslav Bortel, Michal Šimek **Radoslav Bortel** Radoslav Bortel (Gar.)*	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	Differencial 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 bsics of numerical methods (errors in calculations and stability, numerical solutions of algebraic and differential equations and their systems). The course takes advantage of the synnergy 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 fundaments 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, umělecký a společenskovědní seminář	Z	4
B3B01KAT1	Complex Analysis and Transformations	Z,ZK	6
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.			
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 algoritms in computer labs.			
B0B01LAG	Linear Algebra	Z,ZK	8
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.			
B0B35LSP	Logic systems and processors	Z,ZK	6
The course introduces computing resources' basic hardware structures, design, and architecture. It provides an overview of the possibilities of performing data operations at the hardware level and designing embedded processor systems with peripherals on modern FPGA programmable logic circuits, which are increasingly widely used today. Students will learn their description in VHDL, from logic to more complex sequential circuits to practical finite state machine (FSM) designs. They will also master the correct design procedure using circuit simulation. Practical problems are solved using development boards that hundreds of leading universities worldwide also use. The course ends with RISC-V processor structure, cache, and pipeline processing. [last updated January 2024]			
B0B01LGR	Logic and Graphs	Z,ZK	5
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 consequence and of the relationship between a formula and its model is stressed. Further, basic notions from graph theory are introduced.			
B0B01MA1	Mathematical Analysis 1	Z,ZK	7
The aim of the course is to introduce students to basics of differential and integral calculus of functions of one variable.			
B0B01MA2	Mathematical Analysis 2	Z,ZK	7
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.			
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. You will refresh and extend many topics that you know from linear algebra and calculus courses.			

B0B01PST1	Probability and Statistics	Z,ZK	6
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.			
B3B04PRE	Presentation Skills	KZ	2
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.			
B3BPROJ5	Bachelor project	Z	5
B3B35RO1	Robots	KZ	4
B3B33ROB1	Robotics	Z,ZK	6
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. Proudu. 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			
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	**English language B1 - classified assessment** *Petra Juna Jennings, Markéta Havlíčková, Pavla Péterová, Erik Peter Stadnik, Michael Ynsua, Dana Saláková* ***Petra Juna Jennings*** *Petra Juna Jennings (Gar.)*	KZ	0	0C	Z,L	P
B0B04B2Z	**English language B2 - exam** *Petra Juna Jennings, Markéta Havlíčková, Michael Ynsua, Dana Saláková* ***Petra Juna Jennings*** *Petra Juna Jennings (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	KZ	0
verifying of the student´s skills of B1 level			
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: http://jazyky.fel.cvut.cz/			

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 12 credits
Requirement courses in the group: In this group you have to complete 2 courses
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
A8B37DCMA	**Digital Communications** *Jan Sýkora* ***Jan Sýkora*** *Jan Sýkora (Gar.)*	Z,ZK	6	3P+1C	Z	PV
B3B14EPR1	**Electric Drives for Automation and Robotics** *Jan Bauer, Vít Hlinovský* ***Jan Bauer*** *Jan Bauer (Gar.)*	Z,ZK	6	2P+2L	L	PV
B0B02FVK	**Physics of waves and oscillations**	Z,ZK	6	2P+2C+4D	L	PV
B3B35JVC	**How to make (almost) anything** *Jiří Zemánek* ***Jiří Zemánek*** *Jiří Zemánek (Gar.)*	KZ	6	2P+4L	L	PV
B3B35MSD1	**Modeling and simulation of dynamic systems** *Zdeněk Hurák, Jiří Zemánek* ***Jiří Zemánek*** *Zdeněk Hurák (Gar.)*	Z,ZK	6	2P+2C	Z	PV
B3B38OTE1	**Circuit Technologies** *Jan Holub* ***Jan Holub*** *Jan Holub (Gar.)*	Z,ZK	6	2P+2L	L	PV
B0B01PAN	**Advanced Analysis** *Veronika Sobotíková, Jan Hamhalter* ***Veronika Sobotíková*** *Jan Hamhalter (Gar.)*	Z,ZK	6	2P+2S	L	PV
B3B35PAR1	**Programming of logic controllers and robots** *Martin Hlinovský, Pavel Burget* ***Pavel Burget*** *Pavel Burget (Gar.)*	Z,ZK	6	1P+3L	L	PV
B3B33UROB	**Robot Learning** *Karel Zimmermann* ***Karel Zimmermann*** *Karel Zimmermann (Gar.)*	Z,ZK	6	2P+2C	Z	PV
B3B38VSY1	**Embedded Systems** *Vojtěch Petrucha, Jan Fischer* ***Jan Fischer*** *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

A8B37DCMA	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.

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.

B0B02FVK	Physics of waves and oscillations	Z,ZK	6
B3B35JVC	How to make (almost) anything	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 deep learning methods on known robotic problems, such as semantic segmenation or reactive motion control. The overall goal is timeless universal knowledge rather than listing all known deep learning architectures. Students are assumed to have working prior knowledge of mathematics (gradient, jacobian, hessian, gradient descend, taylor polynomial) and machine learning (bayes risk minimization, linear classifier). The labs are divided into two parts, in the first one, the students will solve elementary deep ML tasks from scratch (including the reimplementation of autograd backpropagation), in the second one, students will build on existing templates in order to solve complex tasks including RL, tranformers and generative networks.

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*** *Martin Hlinovský (Gar.)*	KZ	4	0P+4L	L	PV
B3B38LPE1	**Laboratories of Industrial Electronics** *Tomáš Drábek, Vojtěch Petrucha, Michal Janošek, Jan Fischer* ***Vojtěch Petrucha*** *Vojtěch Petrucha (Gar.)*	KZ	4	0P+4L	L	PV
B3B33LAR	**Laboratory of robotics** *Pavel Krsek, Vladimír Petrík, 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_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	**Ethic 1** *Vladimír Slámečka* ***Vladimír Slámečka*** *Vladimír Slámečka (Gar.)*	KZ	4	2P+2C	Z	V
B0B16FIL	**Philosophy** *Peter Zamarovský* ***Peter Zamarovský*** *Peter Zamarovský (Gar.)*	ZK	2	2P+0S	Z,L	V
B0B16FI1	**Philosophy 1** *Peter Zamarovský* ***Peter Zamarovský*** *Peter Zamarovský (Gar.)*	KZ	4	2P+2S	Z	V
B0B16HTE	**History of technology and economic** *Marcela Efmertová, Jan Mikeš* ***Marcela Efmertová*** *Marcela Efmertová (Gar.)*	ZK	2	2P+0S	Z,L	V
B0B16HT1	**History of science and technology 1** *Marcela Efmertová, Jan Mikeš* ***Marcela Efmertová*** *Marcela Efmertová (Gar.)*	KZ	4	2P+2S	Z	V
B0B16HI1	**History 1** *Milena Josefovičová* ***Milena Josefovičová*** *Milena Josefovičová (Gar.)*	KZ	4	2P+2S	Z	V
B0B16MPS	**Psychology** *Jan Fiala* ***Jan Fiala*** *Jan Fiala (Gar.)*	Z,ZK	4	2P+2S	Z,L	V
B0B16MPL	**Psychology for managers** *Jan Fiala* ***Jan Fiala*** *Jan Fiala (Gar.)*	ZK	2	2P+0S	Z,L	V
A003TV	**Physical Education** ***Jiří Drnek***	Z	2	0+2	L,Z	V

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.

B0B16FI1	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_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)* *Tutors,* ***authors*** *and guarantors (gar.)*	Completion	Credits	Scope	Semester	Role
B0B04A21	**English Language A2-1** ***Dana Saláková***	Z		2s	Z	v
B0B04A22	**English Language A2-2** ***Dana Saláková***	Z	0	2s	L	v
B0B04B11	**English Language B1-1** ***Petra Juna Jennings*** *Petra Juna Jennings (Gar.)*	Z	0	2C	Z	v
B0B04B12	**English Language B1-2** ***Petra Juna Jennings*** *Petra Juna Jennings (Gar.)*	Z	0	2C	L	v
B0B04B21	**English Language B2-1** ***Petra Juna Jennings*** *Petra Juna Jennings (Gar.)*	Z	3	2C	Z	v
B0B04B22	**English Language B2-2** ***Petra Juna Jennings*** *Petra Juna Jennings (Gar.)*	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 universitys 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 universitys 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)* *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

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)* *Tutors,* ***authors*** *and guarantors (gar.)*	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: ~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
A8B37DCMA	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.			
B0B01DRN	Differencial 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 bsics of numerical methods (errors in calculations and stability, numerical solutions of algebraic and differential equations and their systems). The course takes advantage of the synnergy between theoretical and practical point of view.			
B0B01LAG	Linear Algebra	Z,ZK	8
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.			
B0B01LGR	Logic and Graphs	Z,ZK	5
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 consequence and of the relationship between a formula and its model is stressed. Further, basic notions from graph theory are introduced.			
B0B01MA1	Mathematical Analysis 1	Z,ZK	7
The aim of the course is to introduce students to basics of differential and integral calculus of functions of one variable.			
B0B01MA2	Mathematical Analysis 2	Z,ZK	7
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.			
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.			
B0B01PST1	Probability and Statistics	Z,ZK	6
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.			
B0B02FVK	Physics of waves and oscillations	Z,ZK	6
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.			
B0B04B1K	English language B1 - classified assessment	KZ	0
verifying of the student´s skills of B1 level			
B0B04B21	English Language B2-1	Z	3
This course is designed as a full-year, two semester preparation course for the universitys 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 universitys 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: http://jazyky.fel.cvut.cz/			
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.			
B0B16FI1	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. You will refresh and extend many topics that you know from linear algebra and calculus courses.			
B0B35LSP	Logic systems and processors	Z,ZK	6
The course introduces computing resources' basic hardware structures, design, and architecture. It provides an overview of the possibilities of performing data operations at the hardware level and designing embedded processor systems with peripherals on modern FPGA programmable logic circuits, which are increasingly widely used today. Students will learn their description in VHDL, from logic to more complex sequential circuits to practical finite state machine (FSM) designs. They will also master the correct design procedure using circuit simulation. Practical problems are solved using development boards that hundreds of leading universities worldwide also use. The course ends with RISC-V processor structure, cache, and pipeline processing. [last updated January 2024]			
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	Presentation Skills	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 fundaments 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 algoritms 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
B3B33UROB	Robot Learning	Z,ZK	6

The course teaches deep learning methods on known robotic problems, such as semantic segmenation or reactive motion control. The overall goal is timeless universal knowledge rather than listing all known deep learning architectures. Students are assumed to have working prior knowledge of mathematics (gradient, jacobian, hessian, gradient descend, taylor polynomial) and machine learning (bayes risk minimization, linear classifier). The labs are divided into two parts, in the first one, the students will solve elementary deep ML tasks from scratch (including the reimplementation of autograd backpropagation), in the second one, students will build on existing templates in order to solve complex tasks including RL, tranformers and generative networks.

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, umělecký a společenskovědní seminář	Z	4
B3B35JVC	How to make (almost) anything	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. Proudu. 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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