Recomended pass through the study plan

Name of the pass: Cybernetics and Robotics - Passage through study

Faculty/Institute/Others: Faculty of Electrical Engineering
Department:
Pass through the study plan: Cybernetics and Robotics 2016
Branch of study guranteed by the department: Common courses
Guarantor of the study branch:
Program of study: Cybernetics and Robotics
Type of study: Bachelor full-time
Note on the pass:

Coding of roles of courses and groups of courses:
P - compulsory courses of the program, PO - compulsory courses of the branch, Z - compulsory courses, S - compulsory elective courses, PV - compulsory elective courses, F - elective specialized courses, V - elective courses, T - physical training courses

Coding of ways of completion of courses (KZ/Z/ZK) and coding of semesters (Z/L):
KZ - graded assesment, Z - assesment, ZK - examination, L - summer semester, Z - winter semester

Number of semester: 1

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
B3B04PSA	**Academic Writing** *Petra Jennings, Jitka Pinková **Jitka Pinková** Petra Jennings (Gar.)*	KZ	2	2C	Z	P
B3B33ALP	**Algorithms and programming** *Vojtěch Vonásek **Jan Kybic** Jan Kybic (Gar.)*	Z,ZK	6	2P+2C	Z	P
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
B0B01LAG	**Linear Algebra** *Jiří Velebil, Natalie Žukovec, Daniel Gromada, Josef Dvořák, Matěj Dostál **Jiří Velebil** Jiří Velebil (Gar.)*	Z,ZK	8	4P+2S	Z	P
B0B01LGR	**Logic anad Graphs** *Natalie Žukovec, Matěj Dostál, Alena Gollová **Matěj Dostál** Marie Demlová (Gar.)*	Z,ZK	5	3P+2S	Z,L	P
B0B01MA1	**Mathematical Analysis 1** *Josef Dvořák, Martin Křepela, Josef Tkadlec **Josef Tkadlec** Josef Tkadlec (Gar.)*	Z,ZK	7	4P+2S	Z,L	P
B3B35RO	**Robots** ***Michael Šebek***	KZ	2	1P+2L	Z	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

Number of semester: 2

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
B0B35APO	**Computer Architectures** *Petr Štěpán, Pavel Píša, Richard Šusta **Pavel Píša** Pavel Píša (Gar.)*	Z,ZK	5	2P+2L	L	P
B0B01DRN	**Differencial Equations and Numerical Analysis** *Daniel Gromada, Josef Dvořák, Karel Pospíšil, Petr Habala **Petr Habala** Petr Habala (Gar.)*	Z,ZK	4	2P+2C	L	P
B3B02FY1	**Physics 1** *Michal Bednařík, Petr Koníček **Michal Bednařík** Michal Bednařík (Gar.)*	Z,ZK	6	4P+1L+2C	L	P
B0B01MA2	**Mathematical Analysis 2** *Natalie Žukovec, Karel Pospíšil, Martin Křepela, Miroslav Korbelář, Petr Hájek, Martin Bohata, Jaroslav Tišer, Zdeněk Mihula, Paola Vivi **Martin Bohata** Jaroslav Tišer (Gar.)*	Z,ZK	7	4P+2S	L,Z	P
B3B36PRG	**Programming in C** *Jan Faigl **Jan Faigl** Jan Faigl (Gar.)*	Z,ZK	6	2P+2C	L	P
2015_BKYRVOL	**Volitelné odborné předměty**	Min. cours. 0	Min/Max 0/999			V

Number of semester: 3

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
B3B31EPO	**Electronic devices and circuits** *Jiří Hospodka, Jan Havlík **Jiří Hospodka** Jiří Hospodka (Gar.)*	Z,ZK	6	4P+2L	Z	P
B3B02FY2	**Physics 2** *Michal Bednařík **Michal Bednařík** Michal Bednařík (Gar.)*	Z,ZK	6	3P+1L+2C	Z	P
B3B01KAT	**Complex Analysis and Transformations** *Martin Bohata **Martin Bohata** Martin Bohata (Gar.)*	Z,ZK	7	4P+2S	Z	P
B0B35LSP	**Logic systems and processors** *Richard Šusta, Martin Hlinovský **Martin Hlinovský** Zdeněk Hurák (Gar.)*	Z,ZK	6	2P+2L	L	P
B3B31SAS	**Signals and systems** *Radoslav Bortel, Pavel Sovka, Tomáš Bořil **Pavel Sovka** Pavel Sovka (Gar.)*	Z,ZK	5	2P+2C	Z	P

Number of semester: 4

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
B3B35ARI	**Automatic Control** *Michael Šebek **Michael Šebek***	Z,ZK	7	4P+2L	L	P
B3B33KUI	**Cybernetics and Artificial Intelligence** *Tomáš Svoboda, Petr Pošík **Tomáš Svoboda** Tomáš Svoboda (Gar.)*	Z,ZK	6	2P+2C	L	P
B0B01PST	**Probability and Statistics** *Miroslav Korbelář, Matvei Slavenko, Kateřina Helisová, Veronika Sobotíková **Kateřina Helisová** Petr Hájek (Gar.)*	Z,ZK	7	4P+2S	Z	P
B3B38SME	**Sensors and Measurements** *Vojtěch Petrucha, Pavel Ripka **Vojtěch Petrucha** Vojtěch Petrucha (Gar.)*	Z,ZK	6	3P+2L	L	P
2015_BKYRLAB	**Povinně volitelné předměty programu - laboratoře** *B3B35LAR,B3B38LPE,..... (see the list of groups below)*	Min. cours. 1 Max. cours. 3	Min/Max 4/12			PV

Number of semester: 5

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
B3B38KDS	**Communication and Distributed Systems** *Jiří Novák, Jan Holub **Jiří Novák** Jiří Novák (Gar.)*	Z,ZK	6	4P+2L	Z	P
B0B33OPT	**Optimization** *Tomáš Werner, Petr Olšák, Mirko Navara, Tomáš Kroupa **Tomáš Kroupa** Tomáš Werner (Gar.)*	Z,ZK	7	4P+2C	Z,L	P
B3BPROJ4	**Bachelor project** *Martin Hlinovský, Petr Pošík, Jana Kostlivá, Tomáš Drábek, Jana Zichová, Drahomíra Hejtmanová, Martin Šipoš, Kamila Krupková Martin Hlinovský (Gar.)*	Z	4	4s	Z	P
B3B33ROB	**Robotics**	Z,ZK	5	2P+2L	Z	P
2015_BKYRPV	**Povinně volitelné předměty programu** *B3B14EPR,B3B35MSD,..... (see the list of groups below)*	Min. cours. 4 Max. cours. 6	Min/Max 16/24			PV

Number of semester: 6

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
BBAP16	**Bachelor thesis**	Z	16	15s	L,Z	P
B3B04PRE	*Petra Jennings, Jitka Pinková **Jitka Pinková** Petra Jennings (Gar.)*	KZ	2	2C	L	P
2015_BKYRPV	**Povinně volitelné předměty programu** *B3B14EPR,B3B35MSD,..... (see the list of groups below)*	Min. cours. 4 Max. cours. 6	Min/Max 16/24			PV

2015_BKYRVOL	**Volitelné odborné předměty**	Min. cours. 0	Min/Max 0/999				V

List of groups of courses of this pass with the complete content of members of individual groups

Kód	Name of the group of courses and codes of members of this group (for specification see here or below the list of courses)	Completion	Credits	Scope	Semester	Role
2015_BKYRLAB	**Povinně volitelné předměty programu - laboratoře**	**Min. cours. 1 Max. cours. 3**	**Min/Max** 4/12			**PV**
B3B35LAR	Laboratory of applied electronic ...	B3B38LPE	Laboratories of Industrial Elect ...	B3B33LAR	Laboratory of robotics	
2015_BKYRPV	**Povinně volitelné předměty programu**	**Min. cours. 4 Max. cours. 6**	**Min/Max** 16/24			**PV**
B3B14EPR	Electric Drive for Automation an ...	B3B35MSD	Modeling and simulation of dynam ...	B3B38OTE	Circuit Technology	
B3B35PAR	Programming of logic controllers ...	B3B38VSY	Embedded Systems	B3B33VIR	Robot Learning	
2015_BKYRVOL	**Volitelné odborné předměty**	**Min. cours. 0**	**Min/Max** 0/999			**V**

List of courses of this pass:

Code	Name of the course	Completion	Credits
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 anad 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.			
B0B01PST	Probability and Statistics	Z,ZK	7
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.			
B0B35APO	Computer Architectures	Z,ZK	5
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.			
B3B01KAT	Complex Analysis and Transformations	Z,ZK	7
B3B02FY1	Physics 1	Z,ZK	6
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
B3B04PSA	Academic Writing	KZ	2

Practically focused course in which students learn how or improve their ability to correctly and effectively formulate common written documents such as their own notes, research, reports, protocols, articles, etc. Students will be acquainted with the main principles of writing professional texts.

B3B14EPR	Electric Drive for Automation and Robotics	Z,ZK	4

The course gives a brief overview of basic types of electric drives. It deals with drives with DC, asynchronous, synchronous and special motors including power electronic converters.Another topics include control strategies such as scalar, vector, direct, sensorless control of AC drives, pulse width modulation strategies and various load types. It is focused on understanding the physical nature of a given type of drive, general derivation of basic differential equations describing transient and steady states, and creating corresponding mathematical models of analyzed systems suitable for both off-line simulation and online-adapted dynamic and real-time control using the basis of modern microprocessor technology. Problems of operating states, sensors and diagnostics of electric drives are also discussed. Basic knowledge of mathematics, mechanics, kinematics, dynamics, theory of electromagnetic field, circuit theory and control theory are assumed.

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.

B3B31SAS	Signals and systems	Z,ZK	5

The course focuses on explaining basic terms used for the description and analysis of determined signals and systems (including filters) in continuous- and discrete-time. The graduate will acquire a basic overview of the issues and learn how to work with concepts, perform simple analysis of systems and signals, and interpret and discuss the results.

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.

B3B33ROB	Robotics	Z,ZK	5

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.

B3B33VIR	Robot Learning	Z,ZK	4

The course teaches application of machine learning methods and optimization on well-known robotic problems, such as semantic segmenation from RGB-D data or reactive motion control. The core of the course represents teaching of deep learning methods. Stidents will use basic knowledge from optimization and linear algebra such as robut 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.

B3B35ARI	Automatic Control	Z,ZK	7

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.

B3B35LAR	Laboratory of applied electronics and control	KZ	4
B3B35MSD	Modeling and simulation of dynamic systems	Z,ZK	4
B3B35PAR	Programming of logic controllers and robots	Z,ZK	4
B3B35RO	Robots	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.

B3B38KDS	Communication and Distributed Systems	Z,ZK	6

The subject is focused on communication principles used within the distributed systems (DS). Initially the physical layer media are described, including communication channel models and analog and digital modulation techniques. Information theory is introduced together with coding methods for error detection, correction and/or information security. Next the general link-layer algorithms are explained (addressing, media access control, flow control, ARQ methods ...). Finally the most widely used distributed systems technologies are presented together with the family of TCP/IP protocols and typical distributed systems applications.

B3B38LPE	Laboratories of Industrial Electronics and Sensors	KZ	4

The objective of the "Laboratories" is to introduce students in a playful and interactive way with basic blocks of an industrial sensor system - from the sensor itself, through signal processing circuits, analog to digital signal conversion, software processing by a microcontroller up to the sending of the results to the superior system or database and their presentation to the user within the concept "Internet of Things".

B3B38OTE	Circuit Technology	Z,ZK	4
Basic types of circuits and blocks of digital measuring instruments are described and analysed. Range and linearity for analogue circuits and interfaces for digital circuits are analysed in detail.			
B3B38SME	Sensors and Measurements	Z,ZK	6
B3B38VSY	Embedded Systems	Z,ZK	4
This subject is focused on the embedded system design, especially using ARM Cortex-M based microcontrollers. The students need to solve two simple and two complex projects of embedded system design using microcontroller. These projects include both circuit and program realization.			
B3BPROJ4	Bachelor project	Z	4
BBAP16	Bachelor thesis	Z	16
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.			

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