Name of study plan: Cybernetics and Robotics

Faculty/Institute/Others: Faculty of Electrical Engineering Department: Branch of study guaranteed by the department: Welcome page Garantor of the study branch: Program of study: Cybernetics and Robotics Type of study: Follow-up master full-time Required credits: 102 Elective courses credits: 18 Sum of credits in the plan: 120 Note on the plan:

Name of the block: Compulsory courses in the program Minimal number of credits of the block: 60 The role of the block: P

Code of the group: 2021_MKYRDIP Name of the group: Diploma Thesis Requirement credits in the group: In this group you have to gain 30 credits Requirement courses in the group: In this group you have to complete 1 course Credits in the group: 30 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
BDIP30	Diploma Thesis	Z	30	22s	L	Р

Characteristics of the courses of this group of Study Plan: Code=2021_MKYRDIP Name=Diploma Thesis

 BDIP30
 Diploma Thesis
 Z
 30

 Independent final comprehensive work for the Master's degree study programme. A student will choose a topic from a range of topics related to his or her branch of study, which will be specified by branch department or branch departments. The diploma thesis will be defended in front of the board of examiners for the comprehensive final examination.

Code of the group: 2021_MKYRP

Name of the group: Compulsory subjects of the programme Requirement credits in the group: In this group you have to gain 30 credits Requirement courses in the group: In this group you have to complete 5 courses Credits in the group: 30 Note on the group:

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
B3M33ARO1	Autonomous Robotics Karel Zimmermann, Vojt ch Vonásek Karel Zimmermann Karel Zimmermann (Gar.)	Z,ZK	6	2P+2L	L	Ρ
B3M38DIT1	Diagnostics and Testing Radislav Šmíd Radislav Šmíd (Gar.)	Z,ZK	6	2P+2L	Z	Р
B3M35LSY1	Linear Systems Petr Hušek Petr Hušek (Gar.)	Z,ZK	6	4P+2C	Z	Ρ
B3MPVTY1	Team Project Petr Drábek, Tomáš Drábek, Ond ej Drbohlav, Martin Hlinovský, Pavel Mužák, Martin Šipoš Ond ej Drbohlav Tomáš Drábek (Gar.)	Z	6	0P+4C	L	Ρ
B3MPROJ6	Project Tomáš Drábek, Martin Hlinovský, Kamila Krupková, Petr Pošík, Jana Zichová, Šárka Hejtmanová, Drahomíra Hejtmanová	Z	6	0p+6s	Z,L	Р

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

B3M33ARO1	Autonomous Robotics	Z,ZK	6
The Autonomous robot	ics course will explain the principles needed to develop algorithms for intelligent mobile robots such as algorithms for: (1) Ma	pping and localiza	tion (SLAM)
sensors calibration (lida	ar or camera). (2) Planning the path in the existing map or planning the exploration in a partially unknown map and performing t	he plan in the wor	Id. IMPORTANT:
It is assumed that stude	ents of this course have a working knowledge of optimization (Gauss-Newton method, Levenberg Marquardt method, full Newton	on method), mathe	matical analysis
(gradient, Jacobian, He	ssian), linear algebra (least-squares method), probability theory (multivariate gaussian probability), statistics (maximum likeli	hood and maximu	m aposteriori
estimate), python progr	amming and machine learning algorithms. This course is also part of the inter-university programme prg.ai Minor. It pools the	best of AI educat	ion in Prague to
provide students with a	deeper and broader insight into the field of artificial intelligence. More information is available at https://prg.ai/minor.		
B3M38DIT1	Diagnostics and Testing	Z,ZK	6
The course aims to intr	oduce students to the problems of modelling and fault detection, ensuring fault tolerance, monitoring the operational status o	f complex industri	al components
and autonomous syste	ms, non-destructive testing and diagnostics of electronic devices with analogue and digital circuits.		
B3M35LSY1	Linear Systems	Z,ZK	6
The purpose of this cou	rrse is to introduce mathematical tools for the description, analysis, and partly also synthesis, of dynamical systems. The focu	is will be on linear	time-invariant
multi-input multi-output	systems and their properties such as stability, controllability, observability and state realization. State feedback, state estimat	tion, and the desig	n of stabilizing
controllers will be expla	ined in detail. Partially covered will be also time-varying and nonlinear systems. Some of the tools introduced in this course an	e readily applicabl	e to engineering
problems such as the a	nalysis of controllability and observability in the design of flexible space structures, the design of state feedback in aircraft co	ntrol, and the estimation	mation of state
variables. The main mo	tivation, however, is to pave the way for the advanced courses of the study program. The prerequsites for this course include ι	undergraduate leve	el linear algebra,
differential equations, a	nd Laplace and z transforms.		
B3MPVTY1	Team Project	Z	6
Teamwork is the basis	of most of the activities that people perform in companies and their personal lives. In this course, students can try how to solv	e a technical task	in a team, how
to cooperate, how to co	mmunicate together and how to solve problems such as project delays, how to include external influences in the plan, etc.		
B3MPROJ6	Project	Z	6
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Name of the block: Compulsory elective courses Minimal number of credits of the block: 42 The role of the block: PV

Code of the group: 2021_MKYRPV1

Name of the group: Compulsory elective subjects of the programme - Group 1 Requirement credits in the group: In this group you have to gain at least 18 credits (at most 36) Requirement courses in the group: In this group you have to complete at least 3 courses (at most 6) Credits in the group: 18 Note on the group:

~Podmínka pro splnění této skupiny předmětů: Studenti musí absolvovat nejméně 3 povinně-volitelné předmětv ze skupiny 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
B4M33MPV	Computer Vision Methods Georgios Tolias, Ji í Matas, Jan ech, Dmytro Mishkin Ond ej Drbohlav Ji í Matas (Gar.)	Z,ZK	6	2P+2C	L	PV
B3M35OFD	Estimation, filtering and detection Vladimír Havlena Vladimír Havlena (Gar.)	Z,ZK	6	2P+2C	Z	PV
B3M35ORR	Optimal and Robust Control Zden k Hurák Zden k Hurák (Gar.)	Z,ZK	6	2P+2C	L	PV
B3M38SPD1	Data Acquisition and Transfer Radislav Šmíd Radislav Šmíd Radislav Šmíd (Gar.)	Z,ZK	6	2P+2L	L	PV
BE4M33SSU	Statistical Machine Learning Jan Drchal, Vojt ch Franc Vojt ch Franc (Gar.)	Z,ZK	6	2P+2C	Z	PV
B3M38ZDS1	Analog Signal Processing and Digitalization Josef Vedral, Michal Janošek Michal Janošek Josef Vedral (Gar.)	Z,ZK	6	2P+2L	Z	PV

Characteristics of the courses of this group of Study Plan: Code=2021_MKYRPV1 Name=Compulsory elective subjects of the programme - Group 1

B4M33MPV	Computer Vision Methods	Z,ZK	6
The course covers sele	cted computer vision problems: search for correspondences between images via interest point detection, description and ma	tching, image stite	ching, detection,
recognition and segmer	tation of objects in images and videos, image retrieval from large databases and tracking of objects in video sequences. This	s course is also p	art of the
inter-university program	me prg.ai Minor. It pools the best of AI education in Prague to provide students with a deeper and broader insight into the fie	ld of artificial intel	ligence. More
information is available	at https://prg.ai/minor.		
B3M35OFD	Estimation, filtering and detection	Z,ZK	6
This course will cover d	escription of the uncertainty of hidden variables (parameters and state of a dynamic system) using the probability language a	and methods for th	neir estimation.
Based on bayesian prot	plem formulation principles of rational behavior under uncertainty will be analyzed and used to develop algorithms for parame	eter estimations (A	ARX models,
Gaussian process regre	ession), filtering (Kalman filter) and detection (likelihood ratio theory) . We will demonstrate numerically robust implementation	of the algorithms	applicable in
real life problems for the	e areas of industrial process control, robotics and avionics.		
B3M35ORR	Optimal and Robust Control	Z,ZK	6
B3M38SPD1	Data Acquisition and Transfer	Z,ZK	6
BE4M33SSU	Statistical Machine Learning	Z,ZK	6
The aim of statistical ma	achine learning is to develop systems (models and algorithms) for learning to solve tasks given a set of examples and some	prior knowledge a	bout the task.
This includes typical tas	ks in speech and image recognition. The course has the following two main objectives 1. to present fundamental learning co	ncepts such as ris	sk minimisation,
maximum likelihood est	mation and Bayesian learning including their theoretical aspects, 2. to consider important state-of-the-art models for classific	ation and regress	sion and to show
how they can be learned	d by those concepts.		

Code of the group: 2021_MKYRPV2

Name of the group: Compulsory elective subjects of the programme - Group 2 Requirement credits in the group: In this group you have to gain at least 24 credits (at most 114) Requirement courses in the group: In this group you have to complete at least 4 courses (at most 19) Credits in the group: 24

Note on the group:

~Podmínka pro splnění této skupiny předmětů: Studenti musí absolvovat celkem 7 povinně volitelných předmětů v součtu ze skupiny 1 a skupiny 2 za splnění podmínky na minimálně 3 absolvované předměty ze skupiny 1.\\

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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
B3M38ASE	Automotive Sensors and Networks Antonín Platil, Ji í Novák, Jan Sobotka Ji í Novák Ji í Novák (Gar.)	Z,ZK	6	2P+2L	L	PV
B3M35DRS	Dynamics and Control Networks Kristian Hengster-Movric Kristian Hengster-Movric	Z,ZK	6	2P+2C	Z	PV
B3M33HRO	Humanoid robots Mat j Hoffmann, Lukáš Rustler Mat j Hoffmann Mat j Hoffmann (Gar.)	Z,ZK	6	2P+2C	L	PV
B3M35HYS	Hybrid Systems Zden k Hurák Zden k Hurák Zden k Hurák (Gar.)	Z,ZK	6	2P+2C		PV
B3M38INA1	Integrated Avionics Martin Šipoš, Jan Rohá Martin Šipoš Jan Rohá (Gar.)	Z,ZK	6	2P+2L	L	PV
B3M35KOA	Combinatorial Algorithms Zden k Hanzálek Zden k Hanzálek (Gar.)	Z,ZK	6	2P+2C	L	PV
B2M32MKSA	Mobile Networks Zden k Be vá, Robert Bešák, Pavel Mach Pavel Mach Zden k Be vá (Gar.)	Z,ZK	6	2P + 2L	Z	PV
B3M33MRS	Multi-robot aerial systems Tomáš Bá a, Martin Saska, Robert P ni ka Martin Saska Martin Saska (Gar.)	Z,ZK	6	2P+2L	z	PV
B3M35NES	Nonlinear Systems and Chaos Kristian Hengster-Movric, Sergej elikovský Sergej elikovský Sergej elikovský (Gar.)	Z,ZK	6	2P+2C	z	PV
B3M33PKR	Advanced robot kinematics Viktor Korotynskiy, Tomáš Pajdla Tomáš Pajdla (Gar.)	Z,ZK	6	2P+2C	Z	PV
B3M38POS	Advanced Sensors Michal Janošek, Antonín Platil Antonín Platil Antonín Platil (Gar.)	Z,ZK	6	2P+2L	Z	PV
B3M35PSR	Real -Time Systems Programming Michal Sojka Michal Sojka Michal Sojka (Gar.)	Z,ZK	6	2P+2C	Z	PV
B3M38PSL1	Aircraft Avionics Martin Šipoš, Jan Rohá Jan Rohá Jan Rohá (Gar.)	Z,ZK	6	2P+2L	Z	PV
B3M35RSA	Automotive Control Systems Tomáš Haniš Tomáš Haniš Tomáš Haniš (Gar.)	Z,ZK	6	2P+2S		PV
B3M35SRL	Flight Control Systems Martin Hrom ík Martin Hrom ík (Gar.)	Z,ZK	6	2P+2L	Z	PV
B4M33TDV	Three-dimensional Computer Vision Radim Šára Radim Šára Radim Šára (Gar.)	Z,ZK	6	2P+2C	Z	PV
B4M36UIR	Artificial Intelligence in Robotics Miloš Prágr, Jan Faigl Jan Faigl Jan Faigl (Gar.)	Z,ZK	6	2P+2C	Z	PV
B3M38VBM1	Videometry and Contactless Measurement Radislav Šmíd Radislav Šmíd Radislav Šmíd (Gar.)	Z,ZK	6	2P+2L	Z	PV
B3M38VIN1	Virtual Instrumentation Antonín Platil, Jaroslav Rozto il Antonín Platil, Antonín Platil (Gar.)	Z,ZK	6	2P+2L	L	PV

Characteristics of the courses of this group of Study Plan: Code=2021_MKYRPV2 Name=Compulsory elective subjects of the programme - Group 2

B3M38ASE Automotive Sensors and Networks	Z,ZK	6
The course provides students with a deeper insight into the functional principles of advanced sensor systems in cars, methods of signal processing in	n sensors and exp	lains how to use
them in vehicle subsystems. It also deals with distributed vehicle systems for real-time control and methods of their testing. Theoretical lectures are con-	nplemented by pra	actical laboratory
teaching with real elements (ECUs, sensors) of modern vehicles.		
B3M35DRS Dynamics and Control Networks	Z,ZK	6
This course responds to an ever-increasing demand for understanding contemporary networks large-scale complex systems composed of many contemporary networks large-scale complex systems complex systems complex systems complex systems complex systems complex systems comp	nponents and sub	osystems
interconnected into a single distributed entity. Herein, we will consider fundamental similarities between diverse areas such as e.g. forecasting the sp	pread of global pa	ndemics, public
opinion dynamics and manipulation of communities through social media, formation controls for unmanned vehicles, energy generation and distribution	in power grids, etc	c. Understanding
such compelling issues goes far beyond the boundaries of any single physical, technological or scientific domain. Therefore, we will analyze phenom	ena across different	ent domains,
involving societal, economic and biological networks. For such networked systems, the resulting behavior depends not only on the characteristics of	their individual co	omponents and
details of their physical or logical interactions, but also on a precise way those components are interconnected the detailed interconnection topology	For that reason,	the first part of
the course introduces fundamental theoretical and abstract computational network analysis concepts; in particular, the algebraic graph theory, network	ork measures and	metrics and
fundamental network algorithms. The second part of the course subsequently views networks as dynamical systems, studies their properties and wa	ays in which these	are controlled,
using mainly methods of automatic control theory.		

B3M33HRO	Humanoid robots	Z,ZK	6
The course focuses on	human-centered robotics: humanoid robots and human-robot interaction. Motivated by the vision of robot companions in our	homes, this cours	se introduces
humanoid robot techno	logy and its specific challenges and opportunities: (i) design, kinematics and inverse kinematics of humanoids, (ii) multimoda	I sensing - vision,	touch, hearing,
inertial sensing, etc., (iii) walking and balancing, and (ii) grasping. The second part of the course centers on human-robot interaction (HRI), which include a set of a second part of the course centers on human-robot interaction (HRI), which include a set of a second part of the course centers on human-robot interaction (HRI), which include a set of a second part of the course centers on human-robot interaction (HRI), which include a set of a second part of the course centers on human-robot interaction (HRI), which include a set of a second part of the course centers on human-robot interaction (HRI), which include a set of a second part of the course centers on human-robot interaction (HRI), which include a set of a second part of the course centers on human-robot interaction (HRI), which include a set of a second part of the course centers on human-robot interaction (HRI), which include a set of a second part of the course centers on human-robot interaction (HRI), which include a second part of the course centers on human-robot interaction (HRI), which include a second part of the course centers on human-robot interaction (HRI), which include a second part of the course centers on human-robot interaction (HRI), which include a second part of the course centers on human-robot interaction (HRI), which include a second part of the course centers on human-robot interaction (HRI), which include a second part of the course centers on human-robot interaction (HRI), which include a second part of the course centers on human-robot interaction (HRI), which include a second part of the course centers on human-robot interaction (HRI), which include a second part of the course centers on human-robot interaction (HRI), which include a second part of the course centers on human-robot interaction (HRI), which include a second part of the course centers on human-robot interaction (HRI), which include a second part of the course centers on human-robot interaction (HRI), which include a second part of the course centers on human-robot interaction (HRI), w	udes physical HRI	(safety aspects,
collaborative robots) an	d cognitive/social HRI - now to design robots and benaviors to be acceptable for people.	7 71	
B3M35HYS	Hybrid Systems	∣ ∠,∠K	6
Hybrid dynamical syste	ms, sometimes also referred to as cyber-physical systems, contain both subsystems governed by physical laws and subsyste the encoded in the form of elegatithms and implemented in coftware. The behaviour of the former can be described by real at	ems benaving acc	cording to logical
continuous or discrete t	ine is commonly modelled by differential or difference equations. The behaviour of the latter is commonly described by real q	tities taking on a c	ountable or finite
number of values (or ev	ren just two in the case of binary quantities) whose evolution is modelled by logical models such as finite state automata or F	Petri nets In the m	odelling and
analysis of hybrid syste	on just the design of control systems for them these two classes of models intersect. However, the control system itself can	also be hybrid A	nd the industrial
reality is that practical c	ontrol systems contain, in addition to the continuous subsystems represented by PID controllers or Kalman filters, a subsystem	em or component	evaluating the
satisfaction of logic con	ditions. Switched linear controllers (gain scheduling), supervisory control, sliding mode control or reset control are examples	of such controller	s with hybrid
dynamics. Hybrid contro	ol methods are also becoming particularly important in a networked environment, where measurements or controls are sent (over the network o	only when some
condition is met, in orde	er to minimize network traffic (event triggered control). Hybrid dynamical systems thus represent a suitable theoretical and ex	tremely practical f	ramework for
modelling, analysis and	synthesis of a large number of practical control systems. The aim of this advanced course is to help students acquire basic of	competences (kno	owledge but also
practical design/comput	tational skills) in this practically very relevant and theoretically still intensively developed area.		
B3M38INA1	Integrated Avionics	Z,ZK	6
The course Integrated N	Modular Avionics (IMA) focuses on a modern concept of the approach to the development and design of aircraft electronics (a	vionics), where th	e transition from
distributed HW systems	to SW blocks. They use high-speed connections to exchange data in applications related to paid air transport. The existing r	regulatory basis a	nd airspace
sharing define the requi	irements for the accuracy, reliability, and functionality of electronic systems even in the event of a failure. In the course, stude	nts will learn deta	ils about the
requirements for so-call	ed safety-critical multi-sensor systems, methods of data processing from predetermined systems, fault detection methods, so	election of primary	y computer and
control system in paralle	el architectures, bus technology, and methods of testing/certification of aircraft instruments.		ſ
B3M35KOA	Combinatorial Algorithms	Z,ZK	6
The goal is to show the	problems and algorithms of combinatorial optimization (often called discrete optimization; there is a strong overlap with the ter	rm operations rese	earch). Following
the courses on linear al	gebra, graph theory, and basics of optimization, we show optimization techniques based on graphs, integer linear programm	ing, heuristics, ap	proximation
algorithms and state sp	ace search methods. We focus on application of optimization in stores, ground transportation, flight transportation, logistics, j	planning of humar	n resources,
scheduling in production	n lines, message routing, scheduling in parallel computers.		
B2M32MKSA	Mobile Networks	Z,ZK	6
The lectures introduce	principles and functionalities of mobile networks with special focus on currently deployed technologies and future mobile networks with special focus on currently deployed technologies and future mobile networks with special focus on currently deployed technologies and future mobile networks with special focus on currently deployed technologies and future mobile networks with special focus on currently deployed technologies and future mobile networks with special focus on currently deployed technologies and future mobile networks with special focus on currently deployed technologies and future mobile networks with special focus on currently deployed technologies and future mobile networks with special focus on currently deployed technologies and future mobile networks with special focus on currently deployed technologies and future mobile networks with special focus on currently deployed technologies and future mobile networks with special focus on currently deployed technologies and future mobile networks with special focus on currently deployed technologies and future mobile networks with special focus on currently deployed technologies and future mobile networks with special focus on currently deployed technologies and future mobile networks with special focus on currently deployed technologies and future mobile networks with special focus on currently deployed technologies and future mobile networks with special focus on currently deployed technologies and future mobile networks with special focus on currently deployed technologies and future mobile networks with special focus on currently deployed technologies and future mobile networks with special focus on currently deployed technologies and focus on currently deployed technologies and future mobile networks with special focus on currently deployed technologies and focus on currently deployed technologies and future mobile networks with special focus on currently deployed technologies and focus on currently deployed technologies and future mobile network	works. Furthermor	e, architecture
and fundamental princip	bles of GSM, UM IS, LIE/LIE-A, and SG will be explained. Then, selected key technologies for future mobile networks (6G) v	vill be explained.	
B3M33MRS	Multi-robot aerial systems	Z,ZK	6
The course offers the in	troduction to multirotor autonomous aerial systems (UAV). Standard senzors and principles of estimate and control of UAV w	vill be introduced.	The problems of
motion planning, path p	ianning, localization, mapping and exploration will be discussed for sigle moving OAV as well as multiple OAVs moving in a to		
B3M35NES	Nonlinear Systems and Chaos	Z,ZK	6
I ne goal of this course i	s to introduce basics of the modern approaches to the theory and applications of nonlinear control. Fundamental difference write a state of the state approaches to the theory and applications of nonlinear control. Fundamental difference write a state of the state approaches to the theory and applications of nonlinear control.	ten dealing with ho	onlinear systems
control compared with t	inear case is that the state space approach prevails, indeed, the nequency response approach is almost useless in nonlinear and differential auxiliance therefore an interfaction to achieve these equations is part of the equipart.	ive methode for or	ace models are
equations will be preser	y differential equations, therefore, an introduction to solving these equations is part of the course. More importantly, the qualitation and the specifically the focus will be on Lyapupov function method enablic	ing to analyse stat	nility of nonlinear
systems not only that c	finear ones. Furthemore, stabilization design methods will be studied in detail, among them the so-called control I vanuous	function concept	and related
backstepping method.	Special stress will be, nevertheless, given by this course to introduce and study methods how to transform complex nonlinear	models to simple	r forms where
more standard linear m	ethods would be applicable. Such an approach is usually refered to as the so-called exact nonlinearity compensation. Contra	ary to the well-kno	wn approximate
linearization this metho	d does not ignore nonlinearities but compensates them up to the best possible extent. The course introduces some interestin	ig case studies as	well, e.g. the
planar vertical take off a	and landing plane ("planar VTOL"), or a simple 2-dimensional model of the walking robot.		
B3M33PKR	Advanced robot kinematics	Z,ZK	6
We will explain and dem	nonstrate techniques for modelling, analyzing and identifying robot kinematics. We will explain more advanced principles of the	representation of	motion in space
and the robot description	ons suitable for identification of kinematic parameters from measured data. We will explain how to solve the inverse kinematic	task of 6DOF ser	rial manipulators
and how it can be used	to identify its kinematic parameters. Theory will be demonstrated on simulated tasks and verified on a real industrial robot.		
B3M38POS	Advanced Sensors	Z,ZK	6
B3M35PSR	Real -Time Systems Programming	Z,ZK	6
The goal of this course	is to provide students with basic knowledge about software development for real-time systems, for example in control and en	nbedded applicati	ons. The focus
is on embedded system	as equipped with a real-time operating system (RTOS). Lectures will cover real-time systems theory, which can be used to for	rmally verify timing	g correctness of
such systems. Another	set of lectures will introduce methods and techniques used for development of safety-critical systems, whose failure may hav	e catastrophic cor	nsequences.
During labs, students w	ill first solve a few simple tasks to familiarize themselves with basic components of VxWorks RTOS and to benchmark the use	ed OS and hardwa	are (Xilinx Zynq).
The obtained metrics re	present the typical criteria for assessing the suitability of a given platform for the given application. After the simple tasks, stu	udents will solve a	complex task of
time-critical motion con-	trol application which will require full utilization of RTOS features. All the tasks at the labs will be implemented in C (or C++) la	anguage.	
B3M38PSL1	Aircraft Avionics	Z,ZK	6
The course acquaints s	tudents with the current technology used in aircraft instruments and unmanned aerial vehicles, ie systems and sensors worki	ing in the low frequ	uency range and
methods used to proces	s their data. The course includes a detailed description of aircraft instrumentation and its resistance to external influences, a de	scription of aircraf	t power sources,
analysis of instruments	and systems for measuring engine and aerometric quantities, and a description of emergency and operational diagnostics. T	he course also de	als with the field
of inertial navigation aid	is, used sensors and systems, their modeling and description. It analyzes in detail the principles of calculations of navigation	equations, includ	ing methods of
	A and their processing.	7 71/	
DOINIOOROA		2,2K	0
B3M35SRL	Flight Control Systems	Z,ZK	6
The course is devoted t	o classical and modern control design techniques for autopilots and flight control systems. Particular levels are discussed, st	arting with the dar	mpers attitude
angle stabilizers, to guid	uance and navigation systems, ivext to the design itself, important aspects of aircraft modelling, both as a rigid body and con-	sidering flexibility	oi the structure,
	Three dimensional Computer Vision	7 71/	<u>^</u>
D4IVIJJIDV	I THEE-UITIETISIONAL COMPUTER VISION	∠,∠K	
able to build variants of	memous and agonumns for our geometric scene reconstruction norm images. The student will understand these methods and simple systems for reconstruction of 3D objects from a set of images or video, for inserting virtual objects to video signal so		iting eqo-motion
trajectory from a seque	nce of images. The labs will be hands-on, the student will be gradually building a small functional 3D scene reconstruction sy	stem and using it	to compute a
virtual 3D model of an o	biject of his/her choice.	and doing it	
	•		

Artificial Intelligence in Robotics			Z	Z,ZK	6
aint students with the use of planning approaches and decision-making techniques of arti	ficial intelligence f	for solving p	roblems ari	sing in autono	mous robotic
course are employing knowledge of planning algorithms, game theory, and solving optimi	zation problems in	selected ap	oplication so	enarios of mo	bile robotics.
tectures of autonomous systems based on reactive and behavioral models of autonomous	systems. The cons	sidered appl	ication scer	arios and robo	otic problems
ersistent environmental monitoring, robotic exploration of unknown environments, online re	eal-time decision-r	making, dec	onfliction in	autonomous s	systems, and
This course is also part of the inter-university programme pro ai Minor. It pools the best of	f Al education in F	Pradue to pr	ovide stude	nts with a dee	ner and
ield of artificial intelligence. More information is available at https://org.ai/minor	A education in F	- lague to pi	UVILLE SLULLE	nis with a uee	per anu
Videometry and Contactless Measurement			7	' 7K	6
CCD and CMOS video sensors, and optoelectronic sensors in general and their use in cont	actless videometri	ic measuren	nent system	s. Further opti	cal radiation,
d its use for acquiring object parameters, optical projection system, design of measuremer	t cameras and pro	ocessing of	their signal	will be present	ed. Students
lebug an independent project - 'Optoelectronic reflective sensor', during labs.					
Virtual Instrumentation			Z	Z,ZK	6
ock: Elective courses					
ver of aredite of the block 0					
er of credits of the block: U					
block: V					
pup: 2021_MKYRH					
oup: Humanities subjects					
redits in the group:					
ourses in the group:					
jioup. o					
oup:				<u>.</u>	
Name of the course / Name of the group of courses					
(in case of groups of courses the list of codes of their members)	Completion	Credits	Scope	Semester	Role
Tutors authors and quarantors (gar)	-		-		
Pater Zamaravalá Pater Zamaravalá Pater Zamaravalá (Car.)	7 7K	5	2P+2S	71	V
History of science and technology 2			21 +20	<u> </u>	v
Marcela Efmertová, Jan Mikeš Marcela Efmertová Marcela Efmertová (Gar.)	Z,ZK	5	2P+2S	Z,L	V
History of economy and social studies	Z,ZK	5	2P+2S	Z,L	V
Psychology	7 71/	5	20,20	71	
Jan Fiala Jan Fiala Jan Fiala (Gar.)	Z,ZR	Э	28+23	Z,L	V
Theology	Z,ZK	5	2P+2S	Z,L	v
Viadimir Siame ka Viadimir Siame ka Viadimir Siame ka (Gar.)					
the courses of this group of Study Plan: Code=2021_MKYRH Nar	ne=Humanitie	es subje	cts		
			Z	Z,ZK	5
					_
History of science and technology 2			Z	Z,ZK	5
History of science and technology 2 rical developments in electrical engineering branches in the world and in the Czech Lands	s. Its ultimate goal	is to stimula	zate students	Z,ZK	5 e history and
History of science and technology 2 rical developments in electrical engineering branches in the world and in the Czech Lands while highlighting the developments in technical education and professional organizations	s. Its ultimate goal s, the process of sl	is to stimula haping scier	ate students	Z,ZK ' interest in the I the influence	5 e history and of technical
History of science and technology 2 rical developments in electrical engineering branches in the world and in the Czech Lands while highlighting the developments in technical education and professional organizations	s. Its ultimate goal , the process of sl	is to stimula haping scier	ate students	Z,ZK interest in the the influence	5 e history and of technical
History of science and technology 2 rical developments in electrical engineering branches in the world and in the Czech Lands while highlighting the developments in technical education and professional organizations History of economy and social studies	s. Its ultimate goal t, the process of sl	is to stimula haping scier	ate students ntific life and	Z,ZK interest in the the influence	5 e history and of technical 5
History of science and technology 2 rical developments in electrical engineering branches in the world and in the Czech Lands while highlighting the developments in technical education and professional organizations History of economy and social studies he history of the Czech society in the 19th - 21th centuries. It follows the forming of the Cz evelopment and coexistence of the various ethnical groups in the Czech countries	s. Its ultimate goal , the process of sl ech political repre	is to stimula haping scier sentation, it	ate students ntific life and 2 2 s aims and	Z,ZK interest in the the influence Z,ZK achieved resu	5 e history and of technical 5 Its as well as
History of science and technology 2 rical developments in electrical engineering branches in the world and in the Czech Lands while highlighting the developments in technical education and professional organizations History of economy and social studies he history of the Czech society in the 19th - 21th centuries. It follows the forming of the Cz evelopment and coexistence of the various ethnical groups in the Czech countries.	s. Its ultimate goal , the process of sl ech political repre	is to stimula haping scier sentation, it	ate students ntific life and z s aims and	Z,ZK interest in the the influence Z,ZK achieved resu	5 e history and of technical 5 lts as well as
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History of science and technology 2 rical developments in electrical engineering branches in the world and in the Czech Lands while highlighting the developments in technical education and professional organizations History of economy and social studies he history of the Czech society in the 19th - 21th centuries. It follows the forming of the Cz evelopment and coexistence of the various ethnical groups in the Czech countries. Psychology Theology students the basic orientation in christian theology and requires no special previous educa-	s. Its ultimate goal , the process of sl ech political repre	is to stimula haping scier sentation, it	ate students ntific life and s aims and 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Z,ZK interest in the the influence Z,ZK achieved resu Z,ZK asic theologic	5 e history and of technical 5 lts as well as 5 5 disciplines
	Particular metagence in NODOLES autin students with the use of planning approaches and decision-making techniques of arti- e course are employing knowledge of planning algorithms, game theory, and solving optimilitectures of autonomous systems based on reactive and behavioral models of autonomous ersistent environmental monitoring, robotic exploration of unknown environments, online re- conflicts. In laboratory exercises, students practice their problem formulations of robotic c. a. This course is also part of the inter-university programme prg.ai Minor. It pools the best of field of artificial intelligence. More information is available at https://prg.ai/minor. Videometry and Contactless Measurement CCD and CMOS video sensors, and optoelectronic sensors in general and their use in cont d its use for acquiring object parameters, optical projection system, design of measuremer debug an independent project - 'Optoelectronic reflective sensor', during labs. Virtual Instrumentation bock: Elective courses er of credits of the block: 0 block: V oup: 2021_MKYRH roup: Humanities subjects tredits in the group: group: 0 oup: group: 0 oup: Name of the course / Name of the group of courses (<i>in case of groups of courses the list of codes of their members</i>) Tutors, authors and guarantors (gar.) Peter Zamarovský Peter Zamarovský Peter Zamarovský (Gar.) History of science and technology 2 Marcela Efmertová, Jan Mikés Marcela Efmertová Marcela Efmertová (Gar.) History of economy and social studies Marcela Efmertová Marcela Efmertová Psychology Jan Fiala Jan Fiala Jan Fiala (Gar.) Theology Viadimír Sláme ka Vladimír Sláme ka Vladimír Sláme ka (Gar.)	Particular intelligence in recordures Particular intelligence in recordures autini students with the use of planning approaches and decision-making techniques of artificial intelligence is course are employing knowledge of planning approaches and behavioral models of autonomous systems. The con- resistent environmental monitoring, robotic exploration of unknown environments, online real-time decision- reconflicts. In laboratory exercises, students practice their problem formulations of robotic challenges and pre- resistent environmental monitoring, robotic exploration of unknown environments, online real-time decision- reconflicts. In laboratory exercises, students practice their problem formulations of robotic challenges and pre- resistent environmental monitoring, robotic sensors in general and their use in contactless videometr di tis use for acquiring object parameters, optical projection system, design of measurement cameras and pre- debug an independent project - Optoelectronic reflective sensor, during labs. Virtual Instrumentation Virtual Instrumentation Pooup: 2021_MKYRH rooup: rooup: 2021_MKYRH rooup: rooup: 0 Diock: V oup: 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.) Z/ZK History of science and technology 2 Marcela Efmertová (Gar.) Z,ZK Psychology Jan Fiala Jan Fiala (Gar.) Z,ZK Psychology Vedimir Sláme ka Vladimír Sláme ka Vladimír Sláme ka (Gar.) Z	A united a menupole of in Course and students with the use of planning approaches and decision-making techniques of artificial intelligence for solving p a course are employing knowledge of planning algorithms, game theory, and solving optimization problems in selected appl resistent environmental monitoring, robotic exploration of unknown environments, online real-time decision- making, dec conflicts. In laboratory exercises, students practice their problem formulations of robotic challenges and practical solutio s. This course is also part of the inter-university programme prg, al Minor. It pools the best of AI education in Prague to pr field of artificial intelligence. More information is available at https://prg.al/minor. Wideometry and Contactless Measurement CCD and CMOS video sensors, and optoelectronic sensors in general and their use in contactless videometric measurer d is use for acquiring object parameters, optical projection system, design of measurement cameras and processing of rabug an independent project - 'Optoelectronic reflective sensor', during labs. Wirtual Instrumentation ock: Elective courses er of credits of the block: 0 block: V oup: 2021_MKYRH roup: Humanities subjects redits in the group: group: 0 oup: Dury: Mame of the course / Name of the group of courses (<i>in case of groups of courses the list of codes of their members</i>) Tutors, authors and guarantors (gar.) Peter Zamarovský Peter Zamarovský (Gar.) Z,ZK 5 History of science and technology 2 Marcela Efmertová, Jan Mikeš Marcela Efmertová Marcela Efmertová (Gar.) Z,ZK 5 History of science and technology Jan Fiala Jan Fiala (Gar.) Theology Vadmir Sláme ka Vladimír Sláme ka Vladimír Sláme ka (Gar.) Z,ZK 5	Participant interlingence for Products Participant Participant Participant Partint	Particular intelligence in robusts 2,2,K initial students with the use of planning approaches and decision-making techniques of artificial intelligence for solving problems arising in autono scourse are employing knowledge of planning algorithms, game theory, and solving optimization problems in selected application scenarios of motor course are employing knowledge of planning algorithms, game theory, and solving optimization problems in selected application scenarios of motor services is also part of the inter-university programme prg.al Minor. It pools the best of All education in Prague to provide students with a deel field artificial intelligence. More information is available at https://prg.alminor. Videometry and Contactless Measurement Z,ZK CDD and CMOS video sensors, and optoelectronic entective sensor', during labs. Z,ZK Virtual Instrumentation Z,ZK Cock: Elective courses Correctites subjects ered of artificial intelligence of groups of courses Completion (in case of groups of courses the list of codes of their members) Z,ZK oock: Elective courses / Name of the group of courses Completion Credits Scope Semester oupp: 2021_MKYRH Scope of courses the list of codes of their members) Z,ZK Scope Semester members) Tutors, authors and guarantors (gar.) Z,ZK Scope Semester poloup: Name of the course / Na

- religion from which graws our civilization up.

Code of the group: 2021_MKYRVOL 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
B0M16FIL		Z,ZK	5
B0M16HSD1	History of economy and social studies	Z,ZK	5
This subject deals v	vith the history of the Czech society in the 19th - 21th centuries. It follows the forming of the Czech political representation, its aims a the social and cultural development and coexistence of the various ethnical groups in the Czech countries.	nd achieved result	s as well as
B0M16HVT	History of science and technology 2	Z,ZK	5
This subject traces	historical developments in electrical engineering branches in the world and in the Czech Lands. Its ultimate goal is to stimulate stude	ents' interest in the	history and
traditions of the suc	engineers	and the influence	of technical
B0M16PSM	Psychology	7 7K	5
BOM16TEO	Theology	2,2K	5
This subject provid	es to students the basic orientation in christian theology and requires no special previous education. After short philosophic lecture t	he basic theologic	disciplines
are gone through. T	he subject is determined not only to believer students who want to know the reliable theologic grounding but also above all to ones wh - religion from which graws our civilization up.	o want to get know	Christianity
B2M32MKSA	Mobile Networks	Z,ZK	6
The lectures introd	uce principles and functionalities of mobile networks with special focus on currently deployed technologies and future mobile network	ks. Furthermore, a	rchitecture
and fundar	nental principles of GSM, UMTS, LTE/LTE-A, and 5G will be explained. Then, selected key technologies for future mobile networks (6G) will be explain	ed.
B3M33ARO1	Autonomous Robotics	Z,ZK	6
The Autonomous	robotics course will explain the principles needed to develop algorithms for intelligent mobile robots such as algorithms for: (1) Mapping the second s	ing and localizatio	n (SLAM)
sensors calibration	(lidar or camera). (2) Planning the path in the existing map or planning the exploration in a partially unknown map and performing the p	lan in the world. IN	IPORTANT:
It is assumed that st	udents of this course have a working knowledge of optimization (Gauss-Newton method, Levenberg Marquardt method, full Newton m	ethod), mathemati	cal analysis
(gradient, Jacobia	n, Hessian), linear algebra (least-squares method), probability theory (multivariate gaussian probability), statistics (maximum likelino	od and maximum a	aposteriori n Proguo to
estimate), python p	or and machine learning algorithms. This course is also part of the inter-university programme prg.al minor. It pools the best provide students with a deeper and broader insight into the field of artificial intelligence. More information is available at https://org	ai/minor	II Flague lo
B3M33HRO	Humanoid robots	7 7K	6
The course focus	es on human-centered robotics: humanoid robots and human-robot interaction. Motivated by the vision of robot companions in our ho	omes, this course i	ntroduces
humanoid robot teo	hnology and its specific challenges and opportunities: (i) design, kinematics and inverse kinematics of humanoids, (ii) multimodal se	nsing - vision, touc	ch, hearing,
inertial sensing, etc	, (iii) walking and balancing, and (ii) grasping. The second part of the course centers on human-robot interaction (HRI), which includes	s physical HRI (safe	ety aspects,
	collaborative robots) and cognitive/social HRI - how to design robots and behaviors to be acceptable for people.		
B3M33MRS	Multi-robot aerial systems	Z,ZK	6
The course offers th	ne introduction to multirotor autonomous aerial systems (UAV). Standard senzors and principles of estimate and control of UAV will b	e introduced. The	problems of
motion	planning, path planning, localization, mapping and exploration will be discussed for sigle moving UAV as well as multiple UAVs movi	ng in a formation.	
B3M33PKR	Advanced robot kinematics	Z,ZK	6
vve will explain and	demonstrate techniques for modelling, analyzing and identifying robot kinematics. We will explain more advanced principles of the rep intens suitable for identification of kinematic parameters from measured data. We will explain how to solve the inverse kinematic tas	resentation of moti	ion in space
and the topot desci	prioris suitable for identification of kinematic parameters from measured data. We will explain how to solve the inverse kinematic tas	istrial robot	lanipulators
B3M35DRS	Dynamics and Control Networks	7 7K	6
This course res	bonds to an ever-increasing demand for understanding contemporary networks large-scale complex systems composed of many cor	ا ہے،۔۔ nponents and sub	svstems
interconnected into	a single distributed entity. Herein, we will consider fundamental similarities between diverse areas such as e.g. forecasting the sprea	d of global pander	nics, public
opinion dynamics ar	nd manipulation of communities through social media, formation controls for unmanned vehicles, energy generation and distribution in p	ower grids, etc. Un	derstanding
such compelling is	ssues goes far beyond the boundaries of any single physical, technological or scientific domain. Therefore, we will analyze phenome	na across different	domains,
involving societal, e	economic and biological networks. For such networked systems, the resulting behavior depends not only on the characteristics of the	eir individual compo	onents and
details of their phy	sical or logical interactions, but also on a precise way those components are interconnected the detailed interconnection topology. For	or that reason, the	first part of
fundamental netwo	ices rundamental theoretical and abstract computational network analysis concepts; in particular, the algebraic graph theory, network analysis concepts; in particular, the algebraic graph theory, network analysis concepts; in particular, the algebraic graph theory, network analysis concepts; in particular, the algebraic graph theory, network analysis concepts; in particular, the algebraic graph theory, network	c measures and m	etrics and
Turiuamentar netwo	using mainly methods of automatic control theory	in which these are	controlled,
B3M35HYS	Hybrid Systems	7 7K	6
Hybrid dynamical s	vstems, sometimes also referred to as cyber-physical systems, contain both subsystems governed by physical laws and subsystems	behaving accordir	na to loaical
rules and regula	tions, often encoded in the form of algorithms and implemented in software. The behaviour of the former can be described by real qu	antities whose evo	plution in
continuous or discre	te time is commonly modelled by differential or difference equations. The behaviour of the latter is commonly described by quantities	taking on a counta	able or finite
number of values	(or even just two in the case of binary quantities), whose evolution is modelled by logical models such as finite state automata or Pe	tri nets. In the mod	elling and
analysis of hybrid s	ystems and the design of control systems for them, these two classes of models intersect. However, the control system itself can als	o be hybrid. And th	e industrial
reality is that pract	ical control systems contain, in addition to the continuous subsystems represented by PID controllers or Kalman filters, a subsystem	or component eva	luating the
dynamics. Hybrid o	ic conditions. Switched linear controllers (gain scheduling), supervisory control, sliding mode control or reset control are examples of	such controllers w	httn nybrid
condition is met in	order to minimize network traffic (event triggered control) Hybrid dynamical systems thus represent a suitable theoretical and extre	mely practical fran	nework for
modelling, analysis	and synthesis of a large number of practical control systems. The aim of this advanced course is to help students acquire basic com	petences (knowled	lge but also
0. 7	practical design/computational skills) in this practically very relevant and theoretically still intensively developed area.		•
B3M35KOA	Combinatorial Algorithms	Z,ZK	6
The goal is to show	the problems and algorithms of combinatorial optimization (often called discrete optimization; there is a strong overlap with the term o	perations research). Following
the courses on lir	near algebra, graph theory, and basics of optimization, we show optimization techniques based on graphs, integer linear programmin	g, heuristics, appro	oximation
algorithms and st	ate space search methods. We focus on application of optimization in stores, ground transportation, flight transportation, logistics, pl	anning of human re	esources,
DOMOEL OVA	scheduling in production lines, message routing, scheduling in parallel computers.	7 71/	e
The purpose of the	LITEdI OVSIETTIS	∠,∠N vill be on linear tim	0 e-invariant
multi-input multi-ou	tput systems and their properties such as stability, controllability, observability and state realization. State feedback, state estimation	, and the design of	stabilizing
	· · · · · · · · · · · · · · · · · · ·	,	

controllers will be explained in detail. Partially covered will be also time-varying and nonlinear systems. Some of the tools introduced in this course are readily applicable to engineering
problems such as the analysis of controllability and observability in the design of flexible space structures, the design of state feedback in aircraft control, and the estimation of state
variables. The main motivation, however, is to pave the way for the advanced courses of the study program. The prerequsites for this course include undergraduate level linear algebra,
differential equations and Laplace and = transforms

DOMOSTICO			
B3M35NES	Nonlinear Systems and Chaos	Z,ZK	6
The goal of this cou	rse is to introduce basics of the modern approaches to the theory and applications of nonlinear control. Fundamental difference when o	dealing with nonline	ear systems
control compared v	vith linear case is that the state space approach prevails. Indeed, the frequency response approach is almost useless in nonlinear co	ontrol. State space	models are
equations will be pr	analy differential equations, therefore, an introduction to solving these equations is part of the course. More importantly, the qualitative in esented, among them I vanunov stability theory is crucial. More specifically, the focus will be on I vanunov function method enabling to	o analyse stability (of nonlinear
systems, not only	v that of linear ones. Furthemore, stabilization desing methods will be studied in detail, among them the so-called control Lyapunov fu	unction concept an	d related
backstepping met	nod. Special stress will be, nevertheless, given by this course to introduce and study methods how to transform complex nonlinear me	odels to simpler for	ms where
more standard line	ar methods would be applicable. Such an approach is usually refered to as the so-called exact nonlinearity compensation. Contrary to	o the well-known a	pproximate
linearization this r	nethod does not ignore nonlinearities but compensates them up to the best possible extent. The course introduces some interesting of	case studies as we	ll, e.g. the
	planar vertical take off and landing plane ("planar VTOL"), or a simple 2-dimensional model of the walking robot.		
B3M35OFD	Estimation, filtering and detection	Z,ZK	6
This course will co	ver description of the uncertainty of hidden variables (parameters and state of a dynamic system) using the probability language and	methods for their	estimation.
Based on bayesia	in problem formulation principles of rational benavior under uncertainty will be analyzed and used to develop algorithms for parameter regression), filtering (Kalman filter) and detection (likelihood ratio theory). We will demonstrate numerically reduct implementation of	f the algorithms and	(models,
Gaussian process	real life problems for the areas of industrial process control robotics and avionics	r the algorithms ap	
B3M35ORR	Ontimal and Robust Control	7 7K	6
B3M35PSR	Real -Time Systems Programming	2,2K	6
The goal of this co	urse is to provide students with basic knowledge about software development for real-time systems, for example in control and embe	∠,∠r	The focus
is on embedded sy	stems equipped with a real-time operating system (RTOS). Lectures will cover real-time systems theory, which can be used to formal	lly verify timing cor	rectness of
such systems. An	other set of lectures will introduce methods and techniques used for development of safety-critical systems, whose failure may have	catastrophic conse	quences.
During labs, studen	ts will first solve a few simple tasks to familiarize themselves with basic components of VxWorks RTOS and to benchmark the used O	S and hardware (X	(ilinx Zynq).
The obtained metric	cs represent the typical criteria for assessing the suitability of a given platform for the given application. After the simple tasks, studen	nts will solve a com	plex task of
time-cr	itical motion control application which will require full utilization of RTOS features. All the tasks at the labs will be implemented in C (c	or C++) language.	
B3M35RSA	Automotive Control Systems	Z,ZK	6
B3M35SRL	Flight Control Systems	Z,ZK	6
The course is dev	oted to classical and modern control design techniques for autopilots and flight control systems. Particular levels are discussed, starti	ing with the dampe	rs attitude
angle stabilizers, to	guidance and navigation systems. Next to the design itself, important aspects of aircraft modelling, both as a rigid body and conside	ering flexibility of the	e structure,
DOMOGACE	are discussed.	7 71/	
	AUTOMOTIVE SENSORS and INETWORKS		0 how to use
them in vehicle sub	solutions with a deeper insight into the functional principles of advanced sensor systems in cars, methods of sight processing in sensor systems in cars, methods of sight processing in sensor systems in the cars, methods of sight processing in sensor systems in the cars, methods of sight processing in sensor systems in the cars, methods of sight processing in sensor systems in the cars, methods of sight processing in sensor systems in the cars, methods of sight processing in sensor systems in the cars, methods of sight processing in sensor systems in the cars, methods of sight processing in sensor systems in the cars, methods of the cars, methods of sight processing in sensor systems in the cars, methods of sight processing in sensor systems in the cars, methods of sensor systems in the	mented by practica	Ilaboratory
	teaching with real elements (ECUs, sensors) of modern vehicles.	include by proceed	aboratory
B3M38DIT1	Diagnostics and Testing	Z.ZK	6
The course aims to	p introduce students to the problems of modelling and fault detection, ensuring fault tolerance, monitoring the operational status of co	mplex industrial co	omponents
	and autonomous systems, non-destructive testing and diagnostics of electronic devices with analogue and digital circuits.		
B3M38INA1	Integrated Avionics	Z,ZK	6
B3M38INA1 The course Integrat	Integrated Avionics ed Modular Avionics (IMA) focuses on a modern concept of the approach to the development and design of aircraft electronics (avior	Z,ZK nics), where the trai	6 nsition from
B3M38INA1 The course Integrat distributed HW s	Integrated Avionics ed Modular Avionics (IMA) focuses on a modern concept of the approach to the development and design of aircraft electronics (avior ystems to SW blocks. They use high-speed connections to exchange data in applications related to paid air transport. The existing re	Z,ZK hics), where the tran gulatory basis and	6 nsition from airspace
B3M38INA1 The course Integrat distributed HW sy sharing define the	Integrated Avionics ed Modular Avionics (IMA) focuses on a modern concept of the approach to the development and design of aircraft electronics (avior ystems to SW blocks. They use high-speed connections to exchange data in applications related to paid air transport. The existing re- e requirements for the accuracy, reliability, and functionality of electronic systems even in the event of a failure. In the course, student on a protocol of data of a processing from prodotormized events for the detection methods a place	Z,ZK nics), where the tran gulatory basis and s will learn details a	6 nsition from airspace about the
B3M38INA1 The course Integrat distributed HW s sharing define the requirements for so	Integrated Avionics ed Modular Avionics (IMA) focuses on a modern concept of the approach to the development and design of aircraft electronics (avion ystems to SW blocks. They use high-speed connections to exchange data in applications related to paid air transport. The existing re- e requirements for the accuracy, reliability, and functionality of electronic systems even in the event of a failure. In the course, student o-called safety-critical multi-sensor systems, methods of data processing from predetermined systems, fault detection methods, select control system in parallel architectures, bus technology, and methods of testing/certification of aircraft instruments	Z,ZK nics), where the tran gulatory basis and s will learn details ction of primary cor	6 nsition from airspace about the nputer and
B3M38INA1 The course Integrat distributed HW s sharing define the requirements for so	Integrated Avionics ed Modular Avionics (IMA) focuses on a modern concept of the approach to the development and design of aircraft electronics (avior ystems to SW blocks. They use high-speed connections to exchange data in applications related to paid air transport. The existing re- e requirements for the accuracy, reliability, and functionality of electronic systems even in the event of a failure. In the course, student o-called safety-critical multi-sensor systems, methods of data processing from predetermined systems, fault detection methods, select control system in parallel architectures, bus technology, and methods of testing/certification of aircraft instruments.	Z,ZK hics), where the trai gulatory basis and s will learn details a tion of primary cor	6 nsition from airspace about the nputer and
B3M38INA1 The course Integrat distributed HW sy sharing define the requirements for so B3M38POS B2M28DSL 1	Integrated Avionics ed Modular Avionics (IMA) focuses on a modern concept of the approach to the development and design of aircraft electronics (avior ystems to SW blocks. They use high-speed connections to exchange data in applications related to paid air transport. The existing re- e requirements for the accuracy, reliability, and functionality of electronic systems even in the event of a failure. In the course, student p-called safety-critical multi-sensor systems, methods of data processing from predetermined systems, fault detection methods, selec control system in parallel architectures, bus technology, and methods of testing/certification of aircraft instruments. Advanced Sensors	Z,ZK hics), where the trai gulatory basis and s will learn details a tion of primary cor Z,ZK	6 nsition from airspace about the nputer and 6
B3M38INA1 The course Integrat distributed HW sy sharing define the requirements for so B3M38POS B3M38PSL1 The course acquair	Integrated Avionics ed Modular Avionics (IMA) focuses on a modern concept of the approach to the development and design of aircraft electronics (avior ystems to SW blocks. They use high-speed connections to exchange data in applications related to paid air transport. The existing re e requirements for the accuracy, reliability, and functionality of electronic systems even in the event of a failure. In the course, student o-called safety-critical multi-sensor systems, methods of data processing from predetermined systems, fault detection methods, selec control system in parallel architectures, bus technology, and methods of testing/certification of aircraft instruments. Advanced Sensors Aircraft Avionics	Z,ZK hics), where the trai gulatory basis and s will learn details a ction of primary cor Z,ZK Z,ZK n the low frequency	6 nsition from airspace about the nputer and 6 6 4 range and
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trajectory from a sequence of images. The labs will be hands-on, the student will be gradually building a small functional 3D scene reconstruction system and using it to compute a virtual 3D model of an object of his/her choice.

Virtual 3D model of an object of nis/her choice.			
B4M36UIR	Artificial Intelligence in Robotics	Z,ZK	6
The course aims to acquaint students with the use of planning approaches and decision-making techniques of artificial intelligence for solving problems arising in autonomous robotic			
systems. Students in the course are employing knowledge of planning algorithms, game theory, and solving optimization problems in selected application scenarios of mobile robotics.			
Students first learn architectures of autonomous systems based on reactive and behavioral models of autonomous systems. The considered application scenarios and robotic problems			
include path planning, persistent environmental monitoring, robotic exploration of unknown environments, online real-time decision-making, deconfliction in autonomous systems, and			
solutions of antagonistic conflicts. In laboratory exercises, students practice their problem formulations of robotic challenges and practical solutions in a realistic robotic simulator or			
consumer mobile robots. This course is also part of the inter-university programme prg.ai Minor. It pools the best of AI education in Prague to provide students with a deeper and			
broader insight into the field of artificial intelligence. More information is available at https://prg.ai/minor.			
BDIP30	Diploma Thesis	Z	30
Independent final comprehensive work for the Master's degree study programme. A student will choose a topic from a range of topics related to his or her branch of study, which will			
be specified by branch department or branch departments. The diploma thesis will be defended in front of the board of examiners for the comprehensive final examination.			
BE4M33SSU	Statistical Machine Learning	Z,ZK	6
The aim of statistical machine learning is to develop systems (models and algorithms) for learning to solve tasks given a set of examples and some prior knowledge about the task.			
This includes typical tasks in speech and image recognition. The course has the following two main objectives 1. to present fundamental learning concepts such as risk minimisation,			
maximum likelihood estimation and Bayesian learning including their theoretical aspects, 2. to consider important state-of-the-art models for classification and regression and to show			
how they can be learned by those concepts.			

For updated information see <u>http://bilakniha.cvut.cz/en/f3.html</u> Generated: day 2025-07-13, time 05:45.