Recomended pass through the study plan

Name of the pass: Bachelor specialization, Information Security, 2021

Faculty/Institute/Others:
Department:
Pass through the study plan: Bachelor Specialization, Information Security, 2021
Branch of study guranteed by the department: Welcome page
Guarantor of the study branch:
Program of study: Informatics
Type of study: Bachelor full-time
Note on the pass: In addition to purely elective courses, compulsory courses in neighboring specializations can also be enrolled here as electives. The BIE-ECC course can be recognized for any active semester after the submission of a certificate certificate that demonstrates their proficiency in English comparable to or exceeding the B2 level of the Common European Framework of Reference for Languages.

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
BIE-DML.21	**Discrete Mathematics and Logic** *Eva Pernecká, Jitka Rybníčková, Francesco Dolce **Eva Pernecká** Eva Pernecká (Gar.)*	Z,ZK	5	2P+1R+1C	Z	PP
BIE-LA1.21	**Linear Algebra 1** *Marzieh Forough **Karel Klouda** Marzieh Forough (Gar.)*	Z,ZK	5	2P+1R+1C	Z	PP
BIE-PA1.21	**Programming and Algorithmics 1** *Jan Trávníček, Ladislav Vagner, Radek Hušek, Josef Vogel **Jan Trávníček** Jan Trávníček (Gar.)*	Z,ZK	7	2P+2R+2C	Z	PP
BIE-GIT.21	**SW Development Technologies** *Petr Pulc **Petr Pulc** Petr Pulc (Gar.)*	Z	3	2P	Z	PP
BIE-TZP.21	**Technological Fundamentals of Computers** *Martin Novotný, Kateřina Hyniová, Matúš Olekšák **Martin Novotný** Martin Novotný (Gar.)*	Z,ZK	5	2P+2C	Z	PP
BIE-UOS.21	**Unix-like Operating Systems** *Jan Trdlička, Zdeněk Muzikář, Jakub Žitný **Zdeněk Muzikář** Zdeněk Muzikář (Gar.)*	KZ	5	2P+2C	Z	PP

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
BIE-PSI.21	**Computer Networks** *Yelena Trofimova, Michal Polák **Yelena Trofimova** Yelena Trofimova (Gar.)*	Z,ZK	5	2P+1R+1C	L	PP
BIE-SAP.21	**Computer Structures and Architectures** *Petr Fišer, Hana Kubátová **Petr Fišer** Petr Fišer (Gar.)*	Z,ZK	5	2P+1R+2C	L	PP
BIE-DBS.21	**Database Systems** *Josef Pavlíček, Otto Šleger, Martin Urbanec **Josef Pavlíček** Josef Pavlíček (Gar.)*	Z,ZK	5	2P+2R+1L	L	PP
BIE-MA1.21	**Mathematical Analysis 1** *Antonella Marchesiello **Tomáš Kalvoda** Tomáš Kalvoda (Gar.)*	Z,ZK	5	2P+1R+1C	L	PP
BIE-PA2.21	**Programming and Algorithmics 2** *Jan Trávníček, Ladislav Vagner, Radek Hušek, Josef Vogel **Jan Trávníček** Jan Trávníček (Gar.)*	Z,ZK	7	2P+1R+2C	L	PP
BIE-V.2021	**Purely Elective Bachelor Courses, Version 2021 till 2024/25** *BIE-ZUM,BIE-ZRS,..... (see the list of groups below)*	Min. cours. 0 Max. cours. 15	Min/Max 0/55			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
BIE-AG1.21	**Algorithms and Graphs 1** *Michal Opler, Dušan Knop, Tomáš Valla, Jiřina Scholtzová, Maria Saumell Mendiola* ***Dušan Knop*** *Dušan Knop (Gar.)*	Z,ZK	5	2P+2C	Z	PP
BIE-AAG.21	**Automata and Grammars** *Jan Holub* ***Jan Holub*** *Jan Holub (Gar.)*	Z,ZK	5	2P+2C	Z	PP
BIE-MA2.21	**Mathematical Analysis 2** *Antonella Marchesiello* ***Tomáš Kalvoda*** *Antonella Marchesiello (Gar.)*	Z,ZK	6	3P+2C	Z	PP
BIE-APS.21	**Architectures of Computer Systems** *Pavel Tvrdík, Michal Štepanovský* ***Pavel Tvrdík*** *Pavel Tvrdík (Gar.)*	Z,ZK	5	2P+2C	Z	PS
BIE-UKB.21	**Introduction to Cybersecurity** *Ivana Trummová, David Pokorný, Jan Bělohoubek, Tomáš Rabas, Tomáš Luňák* ***Jan Bělohoubek*** *Jan Bělohoubek (Gar.)*	Z,ZK	5	3P+1C	Z	PS
BIE-V.2021	**Purely Elective Bachelor Courses, Version 2021 till 2024/25** *BIE-ZUM,BIE-ZRS,..... (see the list of groups below)*	Min. cours. 0 Max. cours. 15	Min/Max 0/55			V

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
BIE-KAB.21	**Cryptography and Security** *František Kovář, Ivana Trummová, David Pokorný, Róbert Lórencz, Jiří Buček, Josef Kokeš, Martin Jureček, Jaroslav Kříž, Filip Kodýtek* ***Jiří Buček*** *Róbert Lórencz (Gar.)*	Z,ZK	5	2P+2C	L	PP
BIE-OSY.21	**Operating Systems** *Jan Trdlička, Pavel Tvrdík, Michal Štepanovský* ***Pavel Tvrdík*** *Pavel Tvrdík (Gar.)*	Z,ZK	5	2P+1R+1L	L	PP
BIE-EHA.21	**Ethical Hacking** *Andrej Šimko, Martin Kolárik, Jiří Dostál* ***Jiří Dostál*** *Jiří Dostál (Gar.)*	Z,ZK	5	2P+2C	L	PS
BIE-BEK.21	**Secure Code** *Josef Kokeš* ***Josef Kokeš*** *Josef Kokeš (Gar.)*	Z,ZK	5	2P+2C	L	PS
BIE-ADU.21	**Unix Administration** *Zdeněk Muzikář, Petr Zemánek* ***Petr Zemánek*** *Petr Zemánek (Gar.)*	Z,ZK	5	2P+2C	L	PS
BIE-V.2021	**Purely Elective Bachelor Courses, Version 2021 till 2024/25** *BIE-ZUM,BIE-ZRS,..... (see the list of groups below)*	Min. cours. 0 Max. cours. 15	Min/Max 0/55			V

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
BIE-BPR.21	**Bachelor Project** ***Zdeněk Muzikář*** *Zdeněk Muzikář (Gar.)*	Z	1		Z,L	PP
BIE-PST.21	**Probability and Statistics** *Francesco Dolce* ***Pavel Hrabák*** *Francesco Dolce (Gar.)*	Z,ZK	5	2P+2C	Z	PP
BIE-ASB.21	**Applied Network Security** *František Kovář, Yelena Trofimova, Jiří Dostál, Martin Šutovský* ***Jiří Dostál*** *Jiří Dostál (Gar.)*	Z,ZK	5	2P+2C	Z	PS
BIE-ZSB.21	**Basics of System Security** *Jiří Buček, Simona Fornůsek, Martin Šutovský, Marián Svetlík* ***Simona Fornůsek*** *Róbert Lórencz (Gar.)*	Z,ZK	5	2P+2C	Z	PS
BIE-HWB.21	**Hardware Security** *Jiří Buček, Filip Kodýtek* ***Jiří Buček*** *Jiří Buček (Gar.)*	Z,ZK	5	2P+2C	Z	PS
BIE-V.2021	**Purely Elective Bachelor Courses, Version 2021 till 2024/25** *BIE-ZUM,BIE-ZRS,..... (see the list of groups below)*	Min. cours. 0 Max. cours. 15	Min/Max 0/55			V

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
BIE-BAP.21	**Bachelor Thesis** *Zdeněk Muzikář* ***Zdeněk Muzikář*** *Zdeněk Muzikář (Gar.)*	Z	14		L,Z	PP
BIE-TDP.21	**Documentation and Presentation** *Dana Vynikarová* ***Dana Vynikarová*** *Dana Vynikarová (Gar.)*	KZ	3	2P+2C	Z,L	PP
BIE-EEC	**English language external certificate** *Zdeněk Muzikář* ***Zdeněk Muzikář*** *Zdeněk Muzikář (Gar.)*	Z	4	2D	L	PP
BIE-IB-PV.21	**Compulsory elective Courses of the Specialization Information Security, version 2021** *BIE-TAB.21,BIE-ZUM.21,..... (see the list of groups below)*	Min. cours. 1 Max. cours. 3	Min/Max 5/15			PV
BIE-V.2021	**Purely Elective Bachelor Courses, Version 2021 till 2024/25** *BIE-ZUM,BIE-ZRS,..... (see the list of groups below)*	Min. cours. 0 Max. cours. 15	Min/Max 0/55			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
BIE-IB-PV.21	**Compulsory elective Courses of the Specialization Information Security, version 2021**	**Min. cours. 1** **Max. cours. 3**	**Min/Max** 5/15			**PV**

BIE-TAB.21	Applications of Security in Tech ...	BIE-ZUM.21	Artificial Intelligence Fundamen ...	BIE-VES.21	Embedded Systems

BIE-V.2021	**Purely Elective Bachelor Courses, Version 2021 till 2024/25**	**Min. cours. 0** **Max. cours. 15**	**Min/Max** 0/55		**V**

BIE-ZUM	Artificial Intelligence Fundamen ...	BIE-ZRS	Basics of Systems Control	BIE-CCN	Compiler Construction
BIE-SCE1	Computer Engineering Seminar I	BIE-SCE2	Computer Engineering Seminar II	BIE-CZ0	Czech Language for Foreigners
BIE-CZ1.21	Czech Language for Foreigners II	UKCJP	Czech language for advanced	BIE-DIF	Differential equations
BIE-EPR	Economic project	BIE-FTR.1	Financial Markets	BIE-HAS	Human Factors in Cryptography an ...
BIE-CSI	Introduction to Computer Science	BIE-EHD	Introduction to European Economi ...	FITE-EHD	Introduction to European Economi ...
BIE-IMA	Introduction to Mathematics	BIE-IMA2	Introduction to Mathematics 2	BIE-ST1	Network Technology 1
BIE-PKM	Preparatory Mathematics	BIE-PJV	Programming in Java	BIE-PS2	Programming in shell 2
FIT-ACM1	Programming Practices 1	FIT-ACM2	Programming Practices 2	FIT-ACM3	Programming Practices 3
FIT-ACM4	Programming Practices 4	FIT-ACM5	Programming Practices 5	FIT-ACM6	Programming Practices 6
BIE-PRR.21	Project management	BIE-SKJ.21	Scripting Languages	BIE-VAK.21	Selected Combinatorics Applicati ...
BIE-VMM	Selected Mathematical Methods	BI-SCE1	Computer Engineering Seminar I	BIE-SEG	Systems Engineering
TVV	Physical education	TVV0	Physical education	TV2K1	Physical Education 2
TVKLV	Physical Education Course	BIE-TUR.21	User Interface Design	BIE-VR1.21	Virtual reality I
BIE-ADW.1	Windows Administration	FITE-SEP	World Economy and Business	BIE-SEP	World Economy and Business
BIE-3DT.1	3D Printing				

List of courses of this pass:

Code	Name of the course	Completion	Credits
BI-SCE1	Computer Engineering Seminar I	Z	4

The Seminar of Computer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance to failures and attacks. Students are approached individually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of the subject is work with scientific

articles and other professional literature and/or work in KČN laboratories. The capacity of the subject is limited by the possibilities of the seminar teachers. The topics are new for each semester.

BIE-3DT.1	3D Printing	KZ	4
Students learn to design three-dimensional objects optimized for printing on a RepRap printer and the printing itself. They will be able to design objects, prepare for printing and print in 3D.			
BIE-AAG.21	Automata and Grammars	Z,ZK	5
Students are introduced to basic theoretical and implementation principles of the following topics: construction, use and mutual transformations of finite automata, regular expressions and regular grammars, translation finite automata, construction and use of pushdown automata, hierarchy of formal languages, relationships between formal languages and automata. Knowledge acquired through the module is applicable in designs of algorithms for searching in text, data compression, simple parsing and translation, and design of digital circuits.			
BIE-ADU.21	Unix Administration	Z,ZK	5
Students will learn the internal structure of the UNIX operating system, with the administration of its basic subsystems and with the security principles. They will understand the differences between user and administrator roles. They will get theoretical and practical knowledge of user management and administration, of users access rights, file systems, disk subsystems, processes, memory, network services and remote access, and in the areas of system deployment and virtualization. In the labs, they will verify the knowledge from the lectures on specific examples from practice.			
BIE-ADW.1	Windows Administration	Z,ZK	4
Students understand the architecture and internals of the Windows OS and acquire the skills to administrate the Windows OS. They are able use the standard administration and security tools and apply advanced ActiveDirectory administration methods. They are able to solve problems by applying appropriate troubleshooting methods and administrate heterogeneous systems. Students are able to effectively configure centralised administration of a computer network.			
BIE-AG1.21	Algorithms and Graphs 1	Z,ZK	5
The course covers the basics from the efficient algorithm design, data structures, and graph theory, belonging to the core knowledge of every computing curriculum. It is interlinked with the concurrent BIE-AAG and BIE-ZDM courses in which the students gain the basic skills and knowledge needed for time and space complexity of algorithms and learn to handle practically the asymptotic mathematics.			
BIE-APS.21	Architectures of Computer Systems	Z,ZK	5
Students will learn the construction principles of internal architecture of computers with universal processors at the level of machine instructions. Special emphasis is given on the pipelined instruction processing and on the memory hierarchy. Students will understand the basic concepts of RISC and CISC architectures and the principles of instruction processing not only in scalar processors, but also in superscalar processors that can execute multiple instructions in one cycle, while ensuring the correctness of the sequential model of the program. The course further elaborates the principles and architectures of shared memory multiprocessor and multicore systems and the memory coherence and consistency in such systems.			
BIE-ASB.21	Applied Network Security	Z,ZK	5
The aim of the course is to introduce selected topics from computer networks in terms of cybersecurity. These topics extend the basic knowledge gained in course BI-PSI with actual security applications like the public key infrastructure, encrypted network protocols, link and network layer security or wireless networks. After finishing the course student will get knowledge of security applications in computer networks.			
BIE-BAP.21	Bachelor Thesis	Z	14
BIE-BEK.21	Secure Code	Z,ZK	5
The students will learn how to assess security risks and how to take them into account in the design phase of their own code and solutions. After getting familiar with the threat modeling theory, students gain practical experience with running programs with reduced privileges and methods of specifying these privileges, since not every program needs to run with administrator privileges. Dangers inherent in buffer overflows will be practically demonstrated. Students will be introduced to the principles of securing data and the relationships of security and database systems, web, remote procedure calls, and sockets in general. The module concludes with Denial of Service attacks and the defense against them.			
BIE-BPR.21	Bachelor Project	Z	1
At the beginning of the semester the student will contact the supervisor of the bachelor thesis he has booked. They will discuss the partial tasks that student will perform during the semester. If he fulfill these tasks, the supervisor will award him / her at the end of the semester with the BI-BPR course.			
BIE-CCN	Compiler Construction	Z,ZK	5
This is an introductory class on compiler construction for bachelor students in computer science. The goal of the class is to introduce basic principles of compilers for students to understand the design and implementation of programming languages. Seeing and actually understanding self-compilation is the overarching theme of the class.			
BIE-CSI	Introduction to Computer Science	Z	2
This is an introductory class on Elementary Computer Science for broad audiences: bachelor students in computer science, students majoring in other fields but interested in computer science, high-school students, anybody with a background in basic math and the desire to understand the absolute basics of computer science. The goal of the class is to introduce and relate basic principles of computer science for students to understand, early on, what computer science is, why things such as high-level programming languages and tools are done the way they are, and even how, on a basic yet representative and practically relevant level. After taking the class, students are able to answer not just basic computer science questions but also questions about themselves such as which courses to take next and which books to follow up with, ideally realizing if they are interested in computer science more than expected, or even less than before.			
BIE-CZ0	Czech Language for Foreigners	KZ	2
Course Czech for foreigners offers the basic topics of conversation: Introductions, Orientation, Shopping, Work / Study, Travel, Time, Family.			
BIE-CZ1.21	Czech Language for Foreigners II	KZ	2
The course is intended for Students of English programmes who have completed BIE-CZ0 course or have basic knowledge of the Czech language. The course further expands the basic vocabulary and clarifies the structure of the Czech language structure with regard to the practical needs of Students residing in the Czech Republic.			
BIE-DBS.21	Database Systems	Z,ZK	5
Students get acquainted with the architecture of the database engine and typical user roles. They learn to design the structure of a smaller data store (including integrity constraints) using a conceptual model and then implement them in a relational database engine. They get acquainted with the SQL language and also with its theoretical basis - relational database model. They will get acquainted with the principles of relational database schema normalization. They understand the basic concepts of transaction processing and control of parallel user access to a single data source. At the end of the course, students will be introduced to alternative nonrelational database models.			
BIE-DIF	Differential equations	Z,ZK	5
This course provides a foundational overview of differential equations, starting with basic motivation and examples of ODEs and progressing to essential solution methods like separation of variables. Key theorems on existence and uniqueness establish when solutions can be guaranteed. Linear and system-based ODEs are covered with methods like characteristic polynomial analysis, followed by examples of non-linear models such as predator-prey and epidemiological models to showcase real-world applications. Finally, an introduction to partial differential equations (PDEs) extends these concepts to multi-variable contexts. The course will also cover numerical methods for solving ODEs and PDEs, including implicit and explicit Euler methods, Runge-Kutta methods, and finite element methods for both ODEs and PDEs.			
BIE-DML.21	Discrete Mathematics and Logic	Z,ZK	5
Students will get acquainted with the basic concepts of propositional logic and predicate logic and learn to work with their laws. Necessary concepts from set theory will be explained. Special attention is paid to relations, their general properties, and their types, especially functional relations, equivalences, and partial orders. The course also lays down the basics of combinatorics and number theory, with emphasis on modular arithmetics.			

BIE-EEC	English language external certificate	Z	4
The BIE-ECC course can be recognized for any active semester after the submission of a certificate certificate that demonstrates their proficiency in English comparable to or exceeding the B2 level of the Common European Framework of Reference for Languages.			
BIE-EHA.21	Ethical Hacking	Z,ZK	5
The goal of the course is to introduce students to the field of penetration testing and ethical hacking. The course deals with cybersecurity threats, vulnerabilities, and their possible exploitation in computer networks, web applications, wireless networks, operating systems, and others like the Internet of Things or cloud. The focus is on hands-on experience with vulnerabilities testing and the following process of penetration test documentation.			
BIE-EHD	Introduction to European Economic History	Z,ZK	3
The course introduces a selection of themes from the European economic history. It gives the student basic knowledge about forming of the global economy through the description of the key periods in history. As European countries have been dominant actors in this process it focuses predominantly on their roles in the economic history. From large economic area of Roman Empire to fragmentation of the Middle Ages, from destruction of WWII to the current affairs, the development of modern financial institutions is deciphered. The course does not cover detailed economic history of particular European countries but rather the impact of trade and role of particular events, institutions and organizations in history. Class meetings will consist of a mixture of lecture and discussion.			
BIE-EPR	Economic project	Z	1
This course is an extension of the course Introduction to European Economic History (BIE-EHD). There is no fixed schedule for BIE-EPR. A teacher will contact you before the start of the semester.			
BIE-FTR.1	Financial Markets	Z,ZK	5
Financial sector has been deeply transformed in the recent years, which led to a development of structured financial products, a new point of view on the issue of credit risk, and globalization of market activities. The need to use and properly apply mathematical and technical tools is emphasized. To manage their financial activities, many firms need graduates from technical schools who have sufficient knowledge ICT and mathematics, and who have at the same time an understanding of the functioning of financial markets. The Financial Markets course thus englobes both a description of financial markets and related economic theories, and an overview of mathematical and statistical tools used in this field.			
BIE-GIT.21	SW Development Technologies	Z	3
This course is aimed at one of the rudimental team software development technology - version control. To be more specific, we will introduce students to Git, the information manager from hell, as Linus Torvalds nicknamed it, and provide a comprehensive guide into its depths, as well as for day-to-day use.			
BIE-HAS	Human Factors in Cryptography and Security	Z,ZK	5
This course is for students interested not only in technical scope of computer science, but also in making products usable - for users and for developers. Students of this course can use their gained knowledge to design, plan and analyse their own projects in the context of human-centered security.			
BIE-HWB.21	Hardware Security	Z,ZK	5
The course deals with hardware resources used to ensure security of computer systems including embedded ones. Students become familiar with the operating principles of cryptographic modules, security features of modern processors, and storage media protection through encryption. They will gain knowledge about vulnerabilities of HW resources, including side-channel attacks and tampering with hardware during manufacture. Students will have an overview of contact and contactless smart card technology including applications and related topics for multi-factor authentication (biometrics). Students will understand methods of efficient implementations of ciphers. Students are expected to have basic knowledge of computer security and cryptography, and basic programming skills before enrolling into the course.			
BIE-IMA	Introduction to Mathematics	Z	4
Students refresh and extend knowledge of elementary functions and their properties. Students understand basic mathematical principles and they are able to apply them in particular examples.			
BIE-IMA2	Introduction to Mathematics 2	Z	2
Students refresh and extend knowledge of elementary functions and their properties. Students understand basic mathematical principles and they are able to apply them in particular examples.			
BIE-KAB.21	Cryptography and Security	Z,ZK	5
Students will understand the mathematical foundations of cryptography and gain an overview of current cryptographic algorithms. They will be able to use cryptographic keys and certificates in systems based on them and learn the basics of safe use of symmetric and asymmetric cryptographic systems and hash functions in applications. Within labs, students will gain practical skills in using standard cryptographic methods with an emphasis on security and will also get acquainted with the basic procedures of cryptanalysis. Students are expected to be competent programmers in C/C++ (on a small scale). Basic Python knowledge is an advantage.			
BIE-LA1.21	Linear Algebra 1	Z,ZK	5
We will introduce students to the basic concepts of linear algebra, such as vectors, matrices, vector spaces. We will define vector spaces over the field of real and complex numbers and also over finite fields. We will present the concepts of basis and dimension and learn to solve systems of linear equations using the Gaussian elimination method (GEM) and show the connection with linear manifolds. We define the regularity of matrices and learn to find their inversions using GEM. We will also learn to find eigenvalues and eigenvectors of a matrix. We will also demonstrate some applications of these concepts in computer science.			
BIE-MA1.21	Mathematical Analysis 1	Z,ZK	5
We begin the course by introducing students to the set of real numbers and its properties, and we note its differences with the set of machine numbers. Then we study real sequences and real functions of a real variable. We gradually introduce the notions of limits of sequences and functions, continuous functions, and derivatives of functions. This theoretical foundation is then applied to root-finding problems (iterative method of bisection and Newtons method), construction of cubic interpolation (spline), and formulation and solution of simple optimization problems (i.e., the issue of finding extrema of functions). The course is closed with the Landaus asymptotic notation and methods of mathematical description of complexity of algorithms.			
BIE-MA2.21	Mathematical Analysis 2	Z,ZK	6
The course completes the theme of analysis of real functions of a real variable initiated in BIE-MA1 by introducing the Riemann integral. Students will learn how to integrate by parts and use the substitution method.The next part of the course is devoted to number series, and Taylor polynomials and series. We apply Taylors theorem to the computation of elementary functions with a prescribed accuracy. Then we study the linear recurrence equations with constant coefficients, the complexity of recursive algorithms, and its analysis using the Master theorem. Finally, we introduce the student to the theory of multivariate functions. After establishing basic concepts of partial derivative, gradient, and Hessian matrix, we study the analytical method of localization of local extrema of multivariate functions as well as the numerical descent method. We conclude the course with the integration of multivariate functions.			
BIE-OSY.21	Operating Systems	Z,ZK	5
In this course that is a follow-up of the Unix-like operating systems course students deepen their knowledge in areas of OS kernels, process and thread implementations, race conditions, critical regions, thread scheduling, shared resource allocation and deadlocks, management of virtual memory and data storages, file systems, OS monitoring. They are able to design and implement simple multithreaded applications. General principles are illustrated on operating systems Solaris, Linux, or MS Windows.			
BIE-PA1.21	Programming and Algorithmics 1	Z,ZK	7
Students learn to construct algorithms for solving basic problems and write them in the C language. They master data types (simple, pointers, structured), expressions, statements, and functions presented in C language. They understand the principle of recursion and basics of algorithm complexity analysis. They know fundamental algorithms for searching, sorting, and manipulating linked lists and trees.			
BIE-PA2.21	Programming and Algorithmics 2	Z,ZK	7
Students know the instruments of object-oriented programming and are able to use them for specifying and implementing abstract data types (stack, queue, enlargeable array, list, set, table). They learn these skills using the C++ programming language and are introduced to all C++ features needed in object-oriented programming (e.g., template programming, copying/moving of objects, operator overloading, inheritance, polymorphism).			

BIE-PJV	Programming in Java	Z,ZK	4
The course Programming in Java will introduce students to the object oriented programming in Java programming language. Beside of basics of Java language the fundamental APIs will also be presented, especially data structures, files, GUI, networking, databases and concurrent APIs.			
BIE-PKM	Preparatory Mathematics	Z	4
The purpose of Preparatory Mathematics is to help students revise the most important topics of high-school mathematics.			
BIE-PRR.21	Project management	Z,ZK	5
The aim of the course is to introduce students into the basic concepts and principles of project management, i.e. methods of planning, teamwork, analysis, crisis management in a project, communication, argumentation and meeting management. Students will practice project management techniques (e.g. SWOT analysis, risk assessment and management, Gantt charts, resource schedule, resource balancing, network graphs) and creation of project documentation. The course is designed especially for students who are interested in deepening their knowledge outside IT, consider starting their own company, or have ambitions to work in middle or senior management positions in large companies. The course is also suitable for all those who will develop software or hardware in the form of team projects.			
BIE-PS2	Programming in shell 2	Z,ZK	4
Students get a general overview of scripting languages, introduction into syntax, semantics, programming style, data structures, pros and cons. In addition, they gain a deeper insight into Bourne Again shell and some other particular scripting languages and will get practical experience with shell script programming. Note to Erasmus students: We are ready do adapt the lectures to provide even very basic Bourne shell usage. Depending on actual knowledge of the students, orientation in user filesystem tools (cp, ln, mkdir, rm...) and useful basic data filtering tools (cut, tr, sort, uniq...) can be provided. The advantage of this module is that we do not stop at this point - we will show you also a selection of advanced scripting techniques used in practice.			
BIE-PSI.21	Computer Networks	Z,ZK	5
The course introduces students to the principles of computer networking. It covers basic technologies, protocols, and services commonly used in local networks and in the Internet as well. The lectures will be amended by proseminars that introduce students into network programming and demonstrate the abilities of advanced network technologies. Students practically verify configurations and management of network devices in the lab within the environment of the operating systems Linux and Cisco IOS.			
BIE-PST.21	Probability and Statistics	Z,ZK	5
Students will learn the basics of probabilistic thinking, the ability to synthesize prior and posterior information and learn to work with random variables. They will be able to apply basic models of random variable distributions and solve applied probabilistic problems in informatics and computer science. Using the statistical induction they will be able to perform estimations of unknown distributional parameters from random sample characteristics. They will also be introduced to the methods for testing statistical hypotheses and determining the statistical dependence of two or more random variables.			
BIE-SAP.21	Computer Structures and Architectures	Z,ZK	5
Students understand basic digital computer units and their structures, functions, and hardware implementation: ALU, control unit, memory system, inputs, outputs, data storage and transfer. In the labs, students gain practical experience with the design and implementation of the logic of a simple processor using modern digital design tools.			
BIE-SCE1	Computer Engineering Seminar I	Z	4
The Seminar of Computer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance to failures and attacks. Students are approached individually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of the subject is work with scientific articles and other professional literature and/or work in KČN laboratories. The capacity of the subject is limited by the possibilities of the seminar teachers. The topics are new for each semester.			
BIE-SCE2	Computer Engineering Seminar II	Z	4
The Seminar of Computer Engineering is a (s)elective course for students who want to deal with deeper topics of digital design, reliability and resistance to failures and attacks. Students are approached individually within the subject. Each student or group of students solves some interesting topic with the selected supervisor. Part of the subject is work with scientific articles and other professional literature and/or work in KČN laboratories. The capacity of the subject is limited by the possibilities of the seminar teachers. The topics are new for each semester.			
BIE-SEG	Systems Engineering	Z	0
This is an introductory class on systems engineering for bachelor students in computer science. The goal of the class is to introduce basic principles of operating systems for students to understand processor and memory virtualization. Seeing and actually understanding virtualization is the overarching theme of the class. After taking the class, students are able to understand the difference between processes and threads as well as emulation and virtualization, what virtual memory is and how it works, what concurrency is, as opposed to parallelism, and how processes and threads synchronize efficiently to overcome concurrency for communication.			
BIE-SEP	World Economy and Business	Z,ZK	4
The course introduces students of technical university to the international business. It does that predominantly by comparing individual countries and key regions of world economy. Students get to know about different religions and cultures, necessary for doing business in diverse societies as well as indexes of economic freedom, corruption and economic development, which are needed for the right investment decision. Seminars help to improve on the knowledge in the form of discussions based on individual readings. It is advised to take bachelor level of this course BIE-SEP as a prerequisite.			
BIE-SKJ.21	Scripting Languages	Z,ZK	4
Join us on a tour into the world of scripted programming. Together, we will unveil the power of Bourne Again shell and PERL as proven industry standards, as well as a couple of other standard text processing utilities (AWK, sed), with some basic UNIX system tools, in many real-world situations like processing web feeds or logs. We will provide a general overview of scripting languages and introduction into their pros and cons and students get practical experience with shell script programming. We will touch also ROFF, PerlDoc, and even TeX to get some insight into how your code documentation can be implemented. And if you know UNIX system-level scripting already, we can show you advanced programming techniques and tricks that get overlooked frequently but increase code robustness or execution efficiency. The course is led by two veteran programmers in the scripting world. Lukáš is a renowned lecturer in advanced shell programming, teaching developers from the IT industry in several CE countries. Jan is a skilled lecturer and developer whose code contributes to safe and streamline operations of cloud service datacenters around the globe.			
BIE-ST1	Network Technology 1	Z	3
The course is focused on essentials of computer networks and practice with network technologies. The course corresponds to the Cisco Netacad curriculum, CCNA1 - R&S Introduction to Networks.			
BIE-TAB.21	Applications of Security in Technology	Z,ZK	5
The goal of the course is to introduce students to selected topics from cybersecurity technical applications that are utilized in different industries. Students get a broader overview of cybersecurity applications and extend their knowledge from the cryptology, the secure code, and system, network, and hardware security.			
BIE-TDP.21	Documentation and Presentation	KZ	3
The course is focused on the basics of creating electronic documentation with emphasis on the creation of technical reports of a larger scope, typically final university theses. Students learn to create text of a technical report in the LaTeX system, process an electronic presentation using the LaTeX Beamer system, and practically present it in front of classmates and the teacher. The course is intended primarily for those students who have chosen the topic of their bachelor's thesis or will choose it within the first 14 days of teaching. Within the exercises of the course, an active approach to the creation of individual parts of the bachelor's thesis is assumed.			
BIE-TUR.21	User Interface Design	Z,ZK	5
Students gain a basic overview of methods for designing and testing common user interfaces. They get experience to solve the problems where software and other products do not communicate with the user optimally, since the needs and characteristics of users are not taken into account during product development. Students gain an overview of methods that bring users into the development process to ensure optimal interface for them.			

BIE-TZP.21	Technological Fundamentals of Computers	Z,ZK	5
Students get acquainted with the fundamentals of digital and analog circuits, as well as basic methods of analyzing them. Students learn how computer structures look like at the lowest level. They are introduced to the function of a transistor. They will understand why processors generate heat, why cooling is necessary, and how to reduce the consumption; what the limits to the maximum operating frequency are and how to raise them; why a computer bus needs to be terminated, what happens if it is not; how a computer power supply looks like (in principle). In the labs, students model the behavior of basic electrical circuits in SW Mathematica.			
BIE-UKB.21	Introduction to Cybersecurity	Z,ZK	5
The goal of the course is to provide students with the introduction of basic concepts in modern approach to cybersecurity. Students will get a basic overview of threats in cyberspace and attacker techniques, security mechanisms in networks, operating systems and applications, as well as of basic cyberspace regulations.			
BIE-UOS.21	Unix-like Operating Systems	KZ	5
Unix-like operating systems represent a large family mostly open-source codes that kept bringing during the history of computers efficient innovative functions of multiuser operating systems for computers and their networks and clusters. The most popular OS today, Android, has a unix kernel. Students get overview of basic properties of this OS family, such as processes and threads, access rights and user identity, filters, or handling files in a file system. They learn to use practically these systems at the level of advanced users who are not only able to utilize powerful system tools that are available to users, but are also able to automatize routine agenda using the unix scripting interface, called shell.			
BIE-VAK.21	Selected Combinatorics Applications	Z	3
The course aims to introduce students in an accessible form to various branches of theoretical computer science and combinatorics. In contrast to the basic courses, we approach the issue from applications to theory. Together, we will first refresh the basic knowledge needed to design and analyze algorithms and introduce some basic data structures. Furthermore, with the active participation of students, we will focus on solving popular and easily formulated problems from various areas of (not only theoretical) informatics. Areas from which we will select problems to be solved will include, for example, graph theory, combinatorial and algorithmic game theory, approximation algorithms, optimization and more. Students will also try to implement solutions to the studied problems with a special focus on the effective use of existing tools.			
BIE-VES.21	Embedded Systems	Z,ZK	5
Students learn to design embedded systems and develop software for them. They get basic knowledge of the most common microcontrollers and embedded processors, their integrated peripheral circuits, programming methods, and applications. They get practical skills with development kits and tools.			
BIE-VMM	Selected Mathematical Methods	Z,ZK	4
The lecture begins with an introduction to the analysis of complex functions of a complex variable. Next, we present the Lebesgue integral. We then address Fourier series and their properties. Further, we introduce and study the properties of the Discrete Fourier Transform (DFT) and its fast implementation (FFT). We discuss the wavelet transform. We examine the linear programming problem in more detail and its solution using the Simplex algorithm. Each topic is demonstrated with interesting examples.			
BIE-VR1.21	Virtual reality I	KZ	4
Introduction to Virtual Reality (VR), virtual reality operations, metaverse, and creation. Rules and requirements for virtual worlds communication. The course focuses on the ways of creating virtual reality worlds and interactive activities in 3D worlds. It improves computational thinking, empathy, and shared social activities.			
BIE-ZRS	Basics of Systems Control	Z,ZK	4
Optional subject Basics of System Control is designed for anyone interested in applied computer science in bachelor studies. A brief introduction to the field of automatic control will be definitely evaluated by our graduates in the industrial practice. Students will gain knowledge in this rapidly evolving field of great future. We will focus our attention particularly on control of engineering and physical systems. We will provide basic information from the feedback control of linear dynamical SISO systems. We will teach you description methods of system models, basic linear dynamic systems analysis and design verification, simple PID feedback, PSD and fuzzy controllers. This is a survey course in which students will learn the methods of creating a description of the system model, the basic linear dynamic systems analysis and design verification and simple PID feedback, PSD and fuzzy controllers. Attention is also given to sensors and actuators in control loops, issues of stability in control systems, single and continuous adjustment of the controller parameters and certain aspects of the industrial implementation of continuous and digital controllers and PLC control. The themes of lectures are accompanied by a number of useful examples and practical industrial implementations.			
BIE-ZSB.21	Basics of System Security	Z,ZK	5
The goal of the course is to provide introduction to basic concepts in security of computer systems. Further, the course introduces the basics of forensic analysis and related topics such as malware analysis or incident response. After finishing the course student will get both theoretical and practical knowledge in the area of modern operating systems security, as well as skills needed for independent work in the area of operating system security incident analysis.			
BIE-ZUM	Artificial Intelligence Fundamentals	Z,ZK	4
Students are introduced to the fundamental problems in the Artificial Intelligence, and the basic methods for their solving. It focuses mainly on the classical tasks from the areas of state space search, multi-agent systems, game theory, planning, and machine learning. Modern soft-computing methods, including the evolutionary algorithms and the neural networks, will be presented as well.			
BIE-ZUM.21	Artificial Intelligence Fundamentals	Z,ZK	5
Students are introduced to the fundamental problems in the Artificial Intelligence, and the basic methods for their solving. It focuses mainly on the classical tasks from the areas of state space search, multi-agent systems, game theory, planning, and machine learning. Modern soft-computing methods, including the evolutionary algorithms and the neural networks, will be presented as well.			
FIT-ACM1	Programming Practices 1	KZ	5
This is a selective course for preparing talented student for representation in international programming contests.			
FIT-ACM2	Programming Practices 2	KZ	5
This is a selective course for preparing talented student for representation in international programming contests.			
FIT-ACM3	Programming Practices 3	KZ	5
This is a selective course for preparing talented student for representation in international programming contests.			
FIT-ACM4	Programming Practices 4	KZ	5
This is a selective course for preparing talented student for representation in international programming contests.			
FIT-ACM5	Programming Practices 5	KZ	5
This is a selective course for preparing talented student for representation in international programming contests.			
FIT-ACM6	Programming Practices 6	KZ	5
This is a selective course for preparing talented student for representation in international programming contests.			
FITE-EHD	Introduction to European Economic History	Z,ZK	3
The course introduces a selection of themes from the European economic history. It gives the student basic knowledge about forming of the global economy through the description of the key periods in history. As European countries have been dominant actors in this process it focuses predominantly on their roles in the economic history. From large economic area of Roman Empire to fragmentation of the Middle Ages, from destruction of WWII to the current affairs, the development of modern financial institutions is deciphered. The course does not cover detailed economic history of particular European countries but rather the impact of trade and role of particular events, institutions and organizations in history. Class meetings will consist of a mixture of lecture and discussion.			
FITE-SEP	World Economy and Business	Z,ZK	4
The course introduces students of technical university to the international business. It does that predominantly by comparing individual countries and key regions of world economy. Students get to know about different religions and cultures, necessary for doing business in diverse societies as well as indexes of economic freedom, corruption and economic			

development, which are needed for the right investment decision. Seminars help to improve on the knowledge in the form of discussions based on individual readings. It is advised to take bachelor level of this course BIE-SEP as a prerequisite.			
TV2K1	Physical Education 2	Z	1
TVKLV	Physical Education Course	Z	0
TVV	Physical education	Z	0
TVV0	Physical education	Z	0
UKCJP	Czech language for advanced	Z,ZK	2
An advanced Czech course for Ukrainian students with refugee status. The exam will confirm knowledge of Czech at B2 level with validity for CTU.			

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