

# Study plan

## Name of study plan: Bachelor specialization Computer Networks and Internet, part-time, in Czech, 2021

Faculty/Institute/Others:

Department:

Branch of study guaranteed by the department: Welcome page

Garantor of the study branch:

Program of study: Informatika

Type of study: Bachelor combined

Required credits: 153

Elective courses credits: 27

Sum of credits in the plan: 180

Note on the plan: Tato verze studijního plánu je určena pro ročníky, které byly přijaty ke studiu od akademického roku 2021/2022 do kombinované formy studia bakalářského programu. . Garant: Ing. Jan Fesl, Ph.D., email: jan.fesl@fit.cvut.cz

Name of the block: Compulsory courses in the program

Minimal number of credits of the block: 106

The role of the block: PP

Code of the group: BIK-PP.21

Name of the group: Compulsory Courses of Bachelor Study Program Informatics, part-time study, version 2021

Requirement credits in the group: In this group you have to gain 106 credits

Requirement courses in the group: In this group you have to complete 20 courses

Credits in the group: 106

Note on the group:

Guarantor:

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
BIK-AG1.21	<b>Algorithms and Graphs 1</b> Radek Hušek, Dušan Knop <b>Dušan Knop</b> Dušan Knop (Gar.)	Z,ZK	5	14KP+4KC	Z	PP
BIK-AAG.21	<b>Automata and Grammars</b> Ondřej Guth, Eliška Šestáková <b>Jan Holub</b> Jan Holub (Gar.)	Z,ZK	5	14KP+4KC	Z	PP
BI-BAP.21	<b>Bachelor Thesis</b> Zdeněk Muzikář	Z	14		L,Z	PP
BIK-BPR.21	<b>Bachelor project</b> Zdeněk Muzikář <b>Zdeněk Muzikář</b> Zdeněk Muzikář (Gar.)	Z	1		Z,L	PP
BIK-DBS.21	<b>Database Systems</b> Monika Borkovcová, Michal Valenta, Andrii Plyskach <b>Monika Borkovcová</b> Monika Borkovcová (Gar.)	Z,ZK	5	14KP+6KC	L	PP
BIK-DML.21	<b>Discrete Mathematics and Logic</b> Eva Pernecká <b>Eva Pernecká</b> Daniel Dombek (Gar.)	Z,ZK	5	14KP+4KC	Z	PP
BIK-KAB.21	<b>Cryptography and Security</b> Jiří Burek, Jiří Dostál, Róbert Lórencz <b>Róbert Lórencz</b> Róbert Lórencz (Gar.)	Z,ZK	5	14KP+4KC	L	PP
BIK-LA1.21	<b>Linear Algebra 1</b> Karel Klouda <b>Karel Klouda</b> Karel Klouda (Gar.)	Z,ZK	5	14KP+4KC	Z	PP
BIK-MA1.21	<b>Mathematical Analysis 1</b> Ivo Petr <b>Ivo Petr</b> Ivo Petr (Gar.)	Z,ZK	5	14KP+4KC	L	PP
BIK-MA2.21	<b>Mathematical Analysis 2</b> Ivo Petr <b>Tomáš Kalvoda</b> Tomáš Kalvoda (Gar.)	Z,ZK	6	21KP+4KC	Z	PP
BIK-OSY.21	<b>Operating Systems</b> Michal Šoch, Jan Trdlík, Pavel Tvrdlík <b>Michal Šoch</b> Michal Šoch (Gar.)	Z,ZK	5	14KP+4KC	L	PP
BIK-PSI.21	<b>Computer Networks</b> Vladimír Smotlacha, Yelena Trofimova <b>Vladimír Smotlacha</b> Vladimír Smotlacha (Gar.)	Z,ZK	5	14KP+4KC	L	PP
BIK-PST.21	<b>Probability and Statistics</b> Daniel Vašata <b>Pavel Hrabák</b> Petr Novák (Gar.)	Z,ZK	5	14KP+4KC	Z	PP

BIK-PA1.21	<b>Programming and Algorithmics 1</b> <i>David Bernhauer, Jan Trávní ek, Ladislav Vagner Jan Trávní ek Jan Trávní ek (Gar.)</i>	Z,ZK	7	14KP+8KC	Z	PP
BIK-PA2.21	<b>Programming and Algorithmics 2</b> <i>David Bernhauer, Jan Trávní ek, Ladislav Vagner Jan Trávní ek Jan Trávní ek (Gar.)</i>	Z,ZK	7	14KP+6KC	L	PP
BIK-SAP.21	<b>Computer Structure and Architecture</b> <i>Martin Da hel Martin Da hel Martin Da hel (Gar.)</i>	Z,ZK	5	14KP+6KC	L	PP
BIK-TZP.21	<b>Technological Fundamentals of Computers</b> <i>Martin Da hel, Kate ina Hyniová, Martin Novotný Martin Da hel Martin Da hel (Gar.)</i>	Z,ZK	5	14KP+4KC	Z	PP
BIK-GIT.21	<b>SW Development Technologies</b> <i>Petr Pulc Petr Pulc Petr Pulc (Gar.)</i>	Z	3	14KP	Z	PP
BIK-TDP.21	<b>Documentation and Presentation</b> <i>Dana Vynikarová</i>	KZ	3	14KP+4KC	Z,L	PP
BIK-UOS.21	<b>Unix-like Operating Systems</b> <i>Jakub Žitný, Petr Zemánek Petr Zemánek Zden k Muziká (Gar.)</i>	KZ	5	14KP+4KC	Z	PP

**Characteristics of the courses of this group of Study Plan: Code=BIK-PP.21 Name=Compulsory Courses of Bachelor Study Program Informatics, part-time study, version 2021**

BIK-AG1.21	<b>Algorithms and Graphs 1</b> The course is presented in Czech. The course covers the basics from the efficient algorithm design, data structures, and graph theory, belonging to the core knowledge of every computing curriculum. Students learn techniques of proofs of correctness of algorithms and techniques of asymptotic mathematics for estimation of their complexity in the best, worse, or average case (the course includes basics from probability theory needed for understanding randomized algorithms). Within exercises students learn applications of studied algorithms for solving practical problems.	Z,ZK	5
BIK-AAG.21	<b>Automata and Grammars</b> 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. Knowledge acquired through the module is applicable to creation of algorithms for pattern matching, data compression, translation, simple parsing, and creation of digital circuits.	Z,ZK	5
BI-BAP.21	<b>Bachelor Thesis</b>	Z	14
BIK-BPR.21	<b>Bachelor project</b> 1. At the beginning of the semester, the student reserves the topic of the bachelor's thesis and connects with the supervisor. He / she will arrange the partial tasks that he / she will perform during the semester to process the assignment. If he completes these tasks, the supervisor will award him a credit from the subject BI-BPR at the end of the semester. 2. The external supervisor enters the information on granting the credit using the form "Granting credit from the external supervisor of the final thesis" ( <a href="http://fit.cvut.cz/student/studijni/formulare">http://fit.cvut.cz/student/studijni/formulare</a> ). The completed and signed form will be handed over by the student to the head of the Department of Defense, who will record the credit in KOS. 3. If the topic of the work that the student has reserved is formulated more generally, the tasks assigned to him by the supervisor for the semester should be aimed primarily at fine-tuning the assignment so that the assignment can be supplemented and approved at the end of the semester.	Z	1
BIK-DBS.21	<b>Database Systems</b> 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.	Z,ZK	5
BIK-DML.21	<b>Discrete Mathematics and Logic</b> 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.	Z,ZK	5
BIK-KAB.21	<b>Cryptography and Security</b> 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.	Z,ZK	5
BIK-LA1.21	<b>Linear Algebra 1</b> 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.	Z,ZK	5
BIK-MA1.21	<b>Mathematical Analysis 1</b> 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 Newton's 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 Landau's asymptotic notation and methods of mathematical description of complexity of algorithms.	Z,ZK	5
BIK-MA2.21	<b>Mathematical Analysis 2</b> The course completes the theme of analysis of real functions of a real variable initiated in BIK-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 Taylor's 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. This course can be enrolled only after successful completion of the course BIK-MA1, which can be replaced by the course BIK-ZMA in the case of repetitive students.	Z,ZK	6
BIK-OSY.21	<b>Operating Systems</b> 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.	Z,ZK	5
BIK-PSI.21	<b>Computer Networks</b> 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.	Z,ZK	5

BIK-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.			
BIK-PA1.21	Programming and Algorithmics 1	Z,ZK	7
Students gain the ability to formulate algorithms for solving basic problems and write them in the C language. They understand data types (simple, structured, pointers), expressions, statements, functions, concept of recursion. They learn to analyse simple cases of algorithm complexity. They know fundamental algorithms for searching, sorting, and manipulating with linked lists.			
BIK-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).			
BIK-SAP.21	Computer Structure and Architecture	Z,ZK	5
Students will get acquainted with the basic architecture and units of a digital computer, understand the structure, function, and implementation of arithmetic-logic unit, controllers, memory, I/O communication, methods of data transfers between the units. The logic design and the implementation of a program-controlled simple processor is practically implemented in the labs using programmable circuits (FPGA), a single-chip microcomputer, and modern design (EDA) tools.			
BIK-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.			
BIK-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.			
BIK-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.			
BIK-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.			

Name of the block: Povinné předměty specializace

Minimal number of credits of the block: 40

The role of the block: PS

Code of the group: BIK-PS-PS.21

Name of the group: Compulsory courses for specialization Computer Networks and Internet, part-time study 2021

Requirement credits in the group: In this group you have to gain 40 credits

Requirement courses in the group: In this group you have to complete 8 courses

Credits in the group: 40

Note on the group:

Garant: Ing. Jan Fesl, Ph.D. email: jan.fesl@fit.cvut.cz

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
BIK-ADU.21	<b>Unix Administration</b> Zdeněk Muzík, Petr Zemánek <b>Petr Zemánek</b> Zdeněk Muzík (Gar.)	Z,ZK	5	14KP+4KC	L	PS
BIK-APS.21	<b>Architectures of Computer Systems</b> Michal Štepanovský, Pavel Tvrdík <b>Michal Štepanovský</b> Pavel Tvrdík (Gar.)	Z,ZK	5	14KP+4KC	Z	PS
BIK-IOT.21	<b>Internet of Things</b> Jan Janeček	Z,ZK	5	14KP+4KC	Z	PS
BIK-SIP.21	<b>Network Programming</b> Jan Fesl Jan Fesl (Gar.)	Z	5	14KP+4KC	Z	PS
BIK-SPS.21	<b>Administration of Computer Networks and Services</b> Pavel Tvrdík Pavel Tvrdík (Gar.)	Z,ZK	5	14KP+4KC	Z	PS
BIK-TPS.21	<b>Computer Networks Technologies</b> Vladimír Smotlacha <b>Vladimír Smotlacha</b> Vladimír Smotlacha (Gar.)	Z,ZK	5	14KP+4KC	Z	PS
BIK-VDC.21	<b>Virtualization and Data Centers</b> Jiří Kašpar <b>Jiří Kašpar</b> Jiří Kašpar (Gar.)	Z,ZK	5	14KP+4KC	L	PS
BIK-VPS.21	<b>Selected Topics in Computer Networking</b> Alexandru Moucha, Mohamed Bettaz <b>Pavel Tvrdík</b> Mohamed Bettaz (Gar.)	Z,ZK	5	14KP+4KC	L	PS

Characteristics of the courses of this group of Study Plan: Code=BIK-PS-PS.21 Name=Compulsory courses for specialization Computer Networks and Internet, part-time study 2021

BIK-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.			
BIK-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.			
BIK-IOT.21	Internet of Things	Z,ZK	5
The course is focused on an overview of technologies and development tools used in the field of the Internet of Things (IoT). Lectures are devoted to an overview of sensors and actuators, wireless communication technologies designed primarily for this area, and appropriate programming methods. They include an overview of IoT architectures for different application areas. Within the computer labs, students will gain practical experience with developing simple IoT systems using common development environments (hardware - ARM, ESP, STM; software - Arduino, Raspberry Pi OS).			
BIK-SIP.21	Network Programming	Z	5
The course covers fundamental topics of programming network applications. It consists of 4 parts. The introductory part is focused on low-level programming using BSD sockets. The second part is devoted to designing communication protocols and their verification. The third part introduces the principles and applications of middleware technologies. The final part introduces basic modern models of distributed computing - P2P and blockchain. All topics will be first explained theoretically and then practices in computer labs using a chosen programming language environment.			
BIK-SPS.21	Administration of Computer Networks and Services	Z,ZK	5
The aim of the course is to deepen the theoretical knowledge of network technologies and protocols in the environment of network servers administrated under the operating systems Linux and Windows. The course syllabus requires the knowledge at the level of courses BIE-PSI, BIE-VPS, and BIE-OSY. Practical skills will be gained by practical hands-on experience with real network infrastructure.			
BIK-TPS.21	Computer Networks Technologies	Z,ZK	5
The course introduces students with basic and advanced technologies, components, and interfaces of contemporary computer networks at the physical layer with the overlap to the link layer. The lectures provide theoretical foundations of these technologies and explain relevant physical principles. In the labs, the respective technologies will be demonstrated and with the most important ones students will get hands-on experience. Thematically, the course covers both local and long-range optical networks, Ethernet, modern wireless networks, always with focus on high-speed networks.			
BIK-VDC.21	Virtualization and Data Centers	Z,ZK	5
The aim of the course is to familiarize students with technology basis of cloud computer systems. It shows principles and techniques used in design and implementation of data center infrastructure, such as various kinds of virtualization and high availability of servers, storages, and software layers. The course guides through data center technologies from private to public and hybrid clouds. Student learn current trends in the architecture of IT infrastructure and its configuration for classic and cloud applications. Students will understand the design, validation, and operation of complex infrastructures for modern applications with respect to scalability and protection against overloads, outages, and data losses.			
BIK-VPS.21	Selected Topics in Computer Networking	Z,ZK	5
The course builds upon the Computer Networks course (BI-PSI), obligatory for the program. Students will learn in detail principles, protocols, and technologies used in modern computer networks from local area networks up to Internet, with focus on switching, routing, security, and virtualization. The emphasis will be on gaining practical experience with real network devices in the lab and learning important methods of local area and wide area networks from the viewpoint of functionality, performance, and security.			

Name of the block: Compulsory elective courses

Minimal number of credits of the block: 5

The role of the block: PV

Code of the group: BIK-PV-PS.21

Name of the group: Compulsory elective courses of the specialization Computer Networks and Internet, version 2021

Requirement credits in the group: In this group you have to gain at least 5 credits (at most 15)

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

Credits in the group: 5

Note on the group: Guarantor: Ing. Jan Fesl, Ph.D. email: jan.fesl@fit.cvut.cz

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
BIK-EHA.21	<b>Ethical Hacking</b> Jakub R ži ka <b>Jakub R ži ka</b> Jakub R ži ka (Gar.)	Z,ZK	5	14KP+4KC	L	PV
BIK-MSI.21	<b>Mobile Networks</b> Pavel Tvrđík	Z,ZK	5	14KP+4KC	L	PV
BIK-ML2.21	<b>Machine Learning 2</b> Daniel Vařata	Z,ZK	5	14KP+4KC	L	PV

**Characteristics of the courses of this group of Study Plan: Code=BIK-PV-PS.21 Name=Compulsory elective courses of the specialization Computer Networks and Internet, version 2021**

BIK-EHA.21	Ethical Hacking	Z,ZK	5
The course gives a professional and academic introduction to computer and information security using the ethical hacking approach, which enables improved defence thanks to adopting an attacker mindset when discovering vulnerabilities, hands-on experience with different attacks, facilitates linking theory and practice in significant areas of one's digital literacy, and can therefore be utilized by (future) security professionals, (informed) decision-makers, (savvy) users and developers alike.			

BIK-MSI.21	Mobile Networks	Z,ZK	5
The goal of the course is to acquaint students with basic principles of mobile networks 4G, 5G and with multimedia data transfers in these networks. Also, students will study the principles of smart cards and their use for authentication of users of mobile networks. The computer labs will be based on simulations of mobile networks. The course builds upon preceding courses BIE-PSI and BIE-VPS and completes the overall student's knowledge mainly in the area of high-speed mobile networks.			
BIK-ML2.21	Machine Learning 2	Z,ZK	5
The goal of this course is to introduce students to the selected advanced methods of machine learning. In the supervised learning scenario, they, in particular, learn kernel methods and neural networks. In the unsupervised learning scenario students learn the principal component analysis and other dimensionality reduction methods. Moreover, students get the basic principles of reinforcement learning and natural language processing.			

Name of the block: Povinná zkouška z angli tiny

Minimal number of credits of the block: 2

The role of the block: PJ

Code of the group: BI-ZKA.21

Name of the group: English Language Exam

Requirement credits in the group: In this group you have to gain at least 2 credits (at most 4)

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

Credits in the group: 2

Note on the group: BI-ANG, ending with an exam for two credits, is enrolled by students who have completed preparator English courses and have a credit from the BI-A2L course. <br> BI-ANG1, ending with an exam for two credits, is enrolled by students who prepared for the exam independently and do not have credit from BI-A2L. These students must complete a credit paper before their own exam. After passing the exam, the student will also be recognized for the course BI-ANGS (Independent preparation for the English exam) for 2 credits. <br> The BIE-ECC course can be recognized for any active semester after the submission of a external certificate at the level of at least B2 according to the Common European Framework of Reference.

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-EEC	English external certificate Zden k Muziká Zden k Muziká Zden k Muziká (Gar.)	Z	4		L	PJ
BI-ANG1	English Language Examination without Preparatory Courses Kate ina Valentová Kate ina Valentová Kate ina Valentová (Gar.)	Z,ZK	2		L	PJ
BI-ANG	English Language, Internal Certificate Kate ina Valentová Kate ina Valentová Kate ina Valentová (Gar.)	ZK	2		Z,L	PJ

Characteristics of the courses of this group of Study Plan: Code=BI-ZKA.21 Name=English Language Exam

BIE-EEC	English 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.			
BI-ANG1	English Language Examination without Preparatory Courses	Z,ZK	2
BI-ANG	English Language, Internal Certificate	ZK	2
Course information and teaching materials can be found at <a href="https://moodle-vyuka.cvut.cz/course/search.php?search=BI-ANG">https://moodle-vyuka.cvut.cz/course/search.php?search=BI-ANG</a>			

Name of the block: Elective courses

Minimal number of credits of the block: 0

The role of the block: V

Code of the group: BIK-V.21

Name of the group: Purely Elective Courses of Bachelor Programme, part-time Study, Version 2021

Requirement credits in the group:

Requirement courses in the group:

Credits in the group: 0

Note on the group: Guarantor: prof. Ing. Róbert Lórencz, CSc., email: robert.lorencz@fit.cvut.cz

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
BIK-ADW.1	Windows Administration Ji í Kašpar, Miroslav Prágl Miroslav Prágl Miroslav Prágl (Gar.)	Z,ZK	4	14KP+2KC	Z	V
BIK-STO	Storage and Filesystems Ji í Kašpar	Z,ZK	4	13KP+4KC	L,Z	V
BIK-EJA	Enterprise Java Ji í Dan ek	KZ	4	13KP+4KC	Z	V

BIK-HMI	<b>History of Mathematics and Informatics</b> <i>Alena Šolcová Alena Šolcová Alena Šolcová (Gar.)</i>	ZK	3	13KP+2KC	L	v
BIK-SQL.1	<b>Language SQL</b> <i>Michal Valenta Michal Valenta Michal Valenta (Gar.)</i>	KZ	4	13KP+4KC	L	v
BIK-OOP	<b>Object-Oriented Programming</b> <i>Filip K ikava Filip K ikava Filip K ikava (Gar.)</i>	Z,ZK	4	14KP+4KC	Z	v
BIK-PJV	<b>Programming in Java</b> <i>Jan Blizni enko Jan Blizni enko Jan Blizni enko (Gar.)</i>	Z,ZK	4	13KP+4KC	Z	v
BIK-PRR.21	<b>Project management</b> <i>David Pešek David Pešek Petra Pavlíková (Gar.)</i>	Z,ZK	5	14KP+4KC	Z	v
BIK-PKM	<b>Introduction to Mathematics</b> <i>Karel Klouda Tomáš Kalvoda (Gar.)</i>	Z	4		Z	v
BIK-TAB.21	<b>Applications of Security in Technology</b> <i>Jiří Dostál</i>	Z,ZK	5	14KP+4KC	L	v
BIK-TUR.21	<b>User Interface Design</b> <i>Jan Schmidt Jan Schmidt Jan Schmidt (Gar.)</i>	Z,ZK	5		L	v
BIK-ZWU	<b>Introduction to Web and User Interfaces</b> <i>Jiří Pavelka</i>	Z,ZK	4	13KP+4KC	Z	v

**Characteristics of the courses of this group of Study Plan: Code=BIK-V.21 Name=Purely Elective Courses of Bachelor Programme, part-time Study, Version 2021**

BIK-ADW.1	Windows Administration This course is presented in Czech.	Z,ZK	4			
BIK-STO	Storage and Filesystems The student will learn principles and current solutions of storage systems architecture. The module explains principles of data store, protection, and archiving, as so as storage scaling, load balancing and high availability.	Z,ZK	4			
BIK-EJA	Enterprise Java The course covers Java technologies (Jakarta EE, Microprofile, etc.) which are used for the development of EIS (Enterprise Information Systems). These applications typically manage persistent data, are accessible to clients via the REST API and are created in the microservice architecture and deployed into orchestrated containers.	KZ	4			
BIK-HMI	History of Mathematics and Informatics This course is presented in Czech.	ZK	3			
BIK-SQL.1	Language SQL Course is based on knowledge obtained in BI-DBS. Students become familiar with advanced relational and non-relational features of SQL language. In particular stored program units, triggers, recursive queries, OLAP support, object-relational constructions. Part of the course is dedicated to practical database optimization from the point of view of specialized database structures like indexes, clusters, index-organized tables, and materialized views. as well as from the point of view query optimization. Execution plan and possibilities of its. changes will be discussed. Lectures will usually discuss SQL standard, but many features will be demonstrated on Oracle DBMS. Seminars are based on Oracle DBMS and partially on PostgreSQL.	KZ	4			
BIK-OOP	Object-Oriented Programming This course is presented in Czech. Object-oriented programming has been used in the last 50 years to solve computational problems by using graphs of objects that collaborate together by message passing. In this course we look at some of the main principles of object-oriented programming and design. The emphasis is on practical techniques for software development including testing, error handling, and design patterns.	Z,ZK	4			
BIK-PJV	Programming in Java This course is presented in Czech. However, there is an English variant in the full-time program Informatics (B1801 / 4753).	Z,ZK	4			
BIK-PRR.21	Project management Project management not only as a common dictionary and setting necessary processes while preparing and / or managing projects, but also as a social art. 20 years of experience not only in IT in various positions and different projects available at your hands.	Z,ZK	5			
BIK-PKM	Introduction to Mathematics This course is presented in Czech.	Z	4			
BIK-TAB.21	Applications of Security in Technology 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.	Z,ZK	5			
BIK-TUR.21	User Interface Design 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.	Z,ZK	5			
BIK-ZWU	Introduction to Web and User Interfaces This course is presented in Czech.	Z,ZK	4			

Code of the group: BIK-PS-VO.21

Name of the group: Elective Vocational Courses for a Bachelor Specialization BIK-PS.21, version 2021

Requirement credits in the group:

Requirement courses in the group:

Credits in the group: 0

Note on the group:

Guarantor: Ing. Jan Fesl, Ph.D. email: jan.fesl@fit.cvut.cz

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) <i>Tutors, authors and guarantors (gar.)</i>	Completion	Credits	Scope	Semester	Role
BIK-AWD.21	<b>Web and Database Server Administration</b> <i>Lukáš Bařinka</i>	Z,ZK	5	14KP+4KC	Z	v

BIK-ASB.21	<b>Applied Network Security</b> <i>Ji í Dostál</i>	Z,ZK	5	14KP+4KC	Z	v
BIK-BEK.21	<b>Secure Code</b> <i>Josef Kokeš, Róbert Lórencz Róbert Lórencz Josef Kokeš (Gar.)</i>	Z,ZK	5	14KP+4KC	L	v
BIK-EHA.21	<b>Ethical Hacking</b> <i>Jakub R ži ka Jakub R ži ka (Gar.)</i>	Z,ZK	5	14KP+4KC	L	v
BIK-HWB.21	<b>Hardware Security</b> <i>Ji í Bu ek</i>	Z,ZK	5	14KP+4KC	Z	v
BIK-KOM.21	<b>Conceptual Modelling</b> <i>Robert Pergl</i>	Z,ZK	5	14KP+4KC	Z	v
BIK-OOP.21	<b>Object-Oriented Programming</b> <i>Filip K ikava</i>	Z,ZK	5	14KP+4KC	Z	v
BIK-PPA.21	<b>Programming Paradigms</b> <i>Jan Janoušek, Jan Sliacký Jan Janoušek Jan Janoušek (Gar.)</i>	Z,ZK	5	14KP+4KC	Z	v
BIK-SWI.21	<b>Software Engineering</b> <i>Ji í Mlejnek, Zden k Rybala Zden k Rybala Ji í Mlejnek (Gar.)</i>	Z,ZK	5	14KP+2KC	L	v
BIK-SP1.21	<b>Team Software Project 1</b> <i>Ji í Mlejnek Ji í Mlejnek Ji í Mlejnek (Gar.)</i>	KZ	5	8KC		v
BIK-SP2.21	<b>Team Software Project 2</b> <i>Ji í Mlejnek</i>	KZ	5	4KC		v
BIK-TAB.21	<b>Applications of Security in Technology</b> <i>Ji í Dostál</i>	Z,ZK	5	14KP+4KC	L	v
BIK-TJV.21	<b>Java Technology</b> <i>Ji í Dan ek Ond ej Guth Ond ej Guth (Gar.)</i>	Z,ZK	5	14KP+4KC	Z	v
BIK-IDO.21	<b>Introduction to DevOps</b> <i>Ji í Mlejnek, Zden k Rybala, Tomáš Vondra Tomáš Vondra Tomáš Vondra (Gar.)</i>	Z,ZK	5	14KP+4KC	Z	v
BIK-UKB.21	<b>Introduction to Cybersecurity</b> <i>Simona Forn sek, Tomáš Lu ák Simona Forn sek (Gar.)</i>	Z,ZK	5	21KP+2KC	Z	v
BIK-ZSB.21	<b>Basics of System Security</b> <i>Simona Forn sek</i>	Z,ZK	5	14KP+4KC	Z	v

**Characteristics of the courses of this group of Study Plan: Code=BIK-PS-VO.21 Name=Elective Vocational Courses for a Bachelor Specialization BIK-PS.21, version 2021**

BIK-EHA.21	Ethical Hacking	Z,ZK	5
The course gives a professional and academic introduction to computer and information security using the ethical hacking approach, which enables improved defence thanks to adopting an attacker mindset when discovering vulnerabilities, hands-on experience with different attacks, facilitates linking theory and practice in significant areas of one's digital literacy, and can therefore be utilized by (future) security professionals, (informed) decision-makers, (savvy) users and developers alike.			
BIK-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.			
BIK-AWD.21	Web and Database Server Administration	Z,ZK	5
Students will get acquainted with the administration of database and web servers and services. They will be able to install, configure, operate, test, and backup complex database and web service systems. The principles will be demonstrated on the PostgreSQL relational database engine and Apache will be used as an example of a web server.			
BIK-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.			
BIK-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.			
BIK-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.			
BIK-KOM.21	Conceptual Modelling	Z,ZK	5
The course is focused on developing abstract thinking and precise formulation skills using conceptual models. Students learn skills of discerning key terms in a domain, the ability to categorize and specify correct relations in complex systems of social reality, mostly enterprises and institutions. Students learn basics of ontological structural modeling in the OntoUML notation. Next, they learn how to express business rules and constraints using the OCL language and foundations of OWL/RDF semantic data representation in the Internet. They also learn the foundations of enterprise engineering, being a discipline for conceptual modelling of enterprises and institutes and their processes. The DEMO method and the BPMN notation will be taught. The course is designed with the respect to continuation in software implementations.			
BIK-OOP.21	Object-Oriented Programming	Z,ZK	5
Object-oriented programming has been used in the last 50 years to solve computational problems by using graphs of objects that collaborate together by message passing. In this course students get acquainted with the main principles of object-oriented programming and design, used in modern programming languages. The emphasis is on practical techniques for developing software, which includes testing, error handling, refactoring, and application of design pattern.			
BIK-PPA.21	Programming Paradigms	Z,ZK	5
The course deals with basic paradigms of high-level programming languages, including their basic execution models, benefits, and limitations of particular approaches. Functional programming paradigm and its basic principles are explained in details. Logic programming is introduced as another way of declarative programming. The principles are demonstrated on lambda calculus and on Lisp (Racket) and Prolog programming languages. Moreover, usage of these principles is demonstrated on modern mainstream programming languages such as C++ and Java.			

BIK-SWI.21	Software Engineering	Z,ZK	5
Students get acquainted with methods of analysis and design of larger software projects that are typically designed and implemented in teams. They consolidate and practically verify their knowledge during the analysis and design of larger software systems that will be developed in the concurrent course BIE-SP1. Students get hands-on experience with CASE tools using the visual language UML for modeling and solving software problems. Students learn the basics of object-oriented analysis, architecture design and testing. Within the course, students also gain a theoretical basis in the field of project management, estimation of costs of software projects, and methods of their development.			
BIK-SP1.21	Team Software Project 1	KZ	5
Students gain hands-on experience with the analysis, design, and prototyping of a large-scale software system. Theoretical support is provided in the BIE-SWI course that runs concurrently and that teaches students necessary techniques and principles. Teams consisting of 4-6 students will work on a specific project. The teacher, in the role of the team and project leader, regularly consults with the team (at the seminars) both the formal and material aspects of the software design. The resulting software artefact will be further developed and finished in the BIE-SP2 course.			
BIK-SP2.21	Team Software Project 2	KZ	5
This course is presented in Czech. However, there is an English variant in the program Informatics (B1801 / 4753).			
BIK-TJV.21	Java Technology	Z,ZK	5
The aim of the course is to provide knowledge and skills needed for the development of smaller and larger information systems. Students will get acquainted with general theoretical concepts and will be able to apply these concepts using libraries and tools from the ecosystem of the Java programming language. After completing the course students will be able to participate in the development of software systems on the Java platform.			
BIK-IDO.21	Introduction to DevOps	Z,ZK	5
The course deals with the topic of DevOps and prepares future developers and administrators for a modern culture of development and operation of systems and services. The course covers the tools to support software development, testing and compilation. It also focuses on tools for automating infrastructure management and building and deploying software to the Cloud. It is an introduction to technologies that will then be discussed in more detail in related follow-up courses. The student will also get acquainted with modern technologies used in practice.			
BIK-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.			
BIK-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.			

### List of courses of this pass:

Code	Name of the course	Completion	Credits
BI-ANG	English Language, Internal Certificate Course information and teaching materials can be found at <a href="https://moodle-vyuka.cvut.cz/course/search.php?search=BI-ANG">https://moodle-vyuka.cvut.cz/course/search.php?search=BI-ANG</a>	ZK	2
BI-ANG1	English Language Examination without Preparatory Courses	Z,ZK	2
BI-BAP.21	Bachelor Thesis	Z	14
BIE-EEC	English external certificate 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.	Z	4
BIK-AAG.21	Automata and Grammars 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. Knowledge acquired through the module is applicable to creation of algorithms for pattern matching, data compression, translation, simple parsing, and creation of digital circuits.	Z,ZK	5
BIK-ADU.21	Unix Administration 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.	Z,ZK	5
BIK-ADW.1	Windows Administration This course is presented in Czech.	Z,ZK	4
BIK-AG1.21	Algorithms and Graphs 1 The course is presented in Czech. The course covers the basics from the efficient algorithm design, data structures, and graph theory, belonging to the core knowledge of every computing curriculum. Students learn techniques of proofs of correctness of algorithms and techniques of asymptotic mathematics for estimation of their complexity in the best, worse, or average case (the course includes basics from probability theory needed for understanding randomized algorithms). Within exercises students learn applications of studied algorithms for solving practical problems.	Z,ZK	5
BIK-APS.21	Architectures of Computer Systems 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.	Z,ZK	5
BIK-ASB.21	Applied Network Security 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.	Z,ZK	5



BIK-AWD.21	Web and Database Server Administration	Z,ZK	5
Students will get acquainted with the administration of database and web servers and services. They will be able to install, configure, operate, test, and backup complex database and web service systems. The principles will be demonstrated on the PostgreSQL relational database engine and Apache will be used as an example of a web server.			
BIK-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.			
BIK-BPR.21	Bachelor project	Z	1
1. At the beginning of the semester, the student reserves the topic of the bachelor's thesis and connects with the supervisor. He / she will arrange the partial tasks that he / she will perform during the semester to process the assignment. If he completes these tasks, the supervisor will award him a credit from the subject BI-BPR at the end of the semester. 2. The external supervisor enters the information on granting the credit using the form "Granting credit from the external supervisor of the final thesis" ( <a href="http://fit.cvut.cz/student/studijni/formulare">http://fit.cvut.cz/student/studijni/formulare</a> ). The completed and signed form will be handed over by the student to the head of the Department of Defense, who will record the credit in KOS. 3. If the topic of the work that the student has reserved is formulated more generally, the tasks assigned to him by the supervisor for the semester should be aimed primarily at fine-tuning the assignment so that the assignment can be supplemented and approved at the end of the semester.			
BIK-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.			
BIK-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.			
BIK-EHA.21	Ethical Hacking	Z,ZK	5
The course gives a professional and academic introduction to computer and information security using the ethical hacking approach, which enables improved defence thanks to adopting an attacker mindset when discovering vulnerabilities, hands-on experience with different attacks, facilitates linking theory and practice in significant areas of one's digital literacy, and can therefore be utilized by (future) security professionals, (informed) decision-makers, (savvy) users and developers alike.			
BIK-EJA	Enterprise Java	KZ	4
The course covers Java technologies (Jakarta EE, Microprofile, etc.) which are used for the development of EIS (Enterprise Information Systems). These applications typically manage persistent data, are accessible to clients via the REST API and are created in the microservice architecture and deployed into orchestrated containers.			
BIK-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.			
BIK-HMI	History of Mathematics and Informatics	ZK	3
This course is presented in Czech.			
BIK-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.			
BIK-IDO.21	Introduction to DevOps	Z,ZK	5
The course deals with the topic of DevOps and prepares future developers and administrators for a modern culture of development and operation of systems and services. The course covers the tools to support software development, testing and compilation. It also focuses on tools for automating infrastructure management and building and deploying software to the Cloud. It is an introduction to technologies that will then be discussed in more detail in related follow-up courses. The student will also get acquainted with modern technologies used in practice.			
BIK-IOT.21	Internet of Things	Z,ZK	5
The course is focused on an overview of technologies and development tools used in the field of the Internet of Things (IoT). Lectures are devoted to an overview of sensors and actuators, wireless communication technologies designed primarily for this area, and appropriate programming methods. They include an overview of IoT architectures for different application areas. Within the computer labs, students will gain practical experience with developing simple IoT systems using common development environments (hardware - ARM, ESP, STM; software - Arduino, Raspberry Pi OS).			
BIK-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.			
BIK-KOM.21	Conceptual Modelling	Z,ZK	5
The course is focused on developing abstract thinking and precise formulation skills using conceptual models. Students learn skills of discerning key terms in a domain, the ability to categorize and specify correct relations in complex systems of social reality, mostly enterprises and institutions. Students learn basics of ontological structural modeling in the OntoUML notation. Next, they learn how to express business rules and constraints using the OCL language and foundations of OWL/RDF semantic data representation in the Internet. They also learn the foundations of enterprise engineering, being a discipline for conceptual modelling of enterprises and institutes and their processes. The DEMO method and the BPMN notation will be taught. The course is designed with the respect to continuation in software implementations.			
BIK-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.			
BIK-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 Newton's 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 Landau's asymptotic notation and methods of mathematical description of complexity of algorithms.			

BIK-MA2.21	Mathematical Analysis 2	Z,ZK	6
<p>The course completes the theme of analysis of real functions of a real variable initiated in BIK-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 Taylor's 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.</p> <p>This course can be enrolled only after successful completion of the course BIK-MA1, which can be replaced by the course BIK-ZMA in the case of repetitive students.</p>			
BIK-ML2.21	Machine Learning 2	Z,ZK	5
<p>The goal of this course is to introduce students to the selected advanced methods of machine learning. In the supervised learning scenario, they, in particular, learn kernel methods and neural networks. In the unsupervised learning scenario students learn the principal component analysis and other dimensionality reduction methods. Moreover, students get the basic principles of reinforcement learning and natural language processing.</p>			
BIK-MSI.21	Mobile Networks	Z,ZK	5
<p>The goal of the course is to acquaint students with basic principles of mobile networks 4G, 5G and with multimedia data transfers in these networks. Also, students will study the principles of smart cards and their use for authentication of users of mobile networks. The computer labs will be based on simulations of mobile networks. The course builds upon preceding courses BIE-PSI and BIE-VPS and completes the overall student's knowledge mainly in the area of high-speed mobile networks.</p>			
BIK-OOP	Object-Oriented Programming	Z,ZK	4
<p>This course is presented in Czech. Object-oriented programming has been used in the last 50 years to solve computational problems by using graphs of objects that collaborate together by message passing. In this course we look at some of the main principles of object-oriented programming and design. The emphasis is on practical techniques for software development including testing, error handling, refactoring and design patterns.</p>			
BIK-OOP.21	Object-Oriented Programming	Z,ZK	5
<p>Object-oriented programming has been used in the last 50 years to solve computational problems by using graphs of objects that collaborate together by message passing. In this course students get acquainted with the main principles of object-oriented programming and design, used in modern programming languages. The emphasis is on practical techniques for developing software, which includes testing, error handling, refactoring, and application of design pattern.</p>			
BIK-OSY.21	Operating Systems	Z,ZK	5
<p>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.</p>			
BIK-PA1.21	Programming and Algorithmics 1	Z,ZK	7
<p>Students gain the ability to formulate algorithms for solving basic problems and write them in the C language. They understand data types (simple, structured, pointers), expressions, statements, functions, concept of recursion. They learn to analyse simple cases of algorithm complexity. They know fundamental algorithms for searching, sorting, and manipulating with linked lists.</p>			
BIK-PA2.21	Programming and Algorithmics 2	Z,ZK	7
<p>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).</p>			
BIK-PJV	Programming in Java	Z,ZK	4
<p>This course is presented in Czech. However, there is an English variant in the full-time program Informatics (B1801 / 4753).</p>			
BIK-PKM	Introduction to Mathematics	Z	4
<p>This course is presented in Czech.</p>			
BIK-PPA.21	Programming Paradigms	Z,ZK	5
<p>The course deals with basic paradigms of high-level programming languages, including their basic execution models, benefits, and limitations of particular approaches. Functional programming paradigm and its basic principles are explained in details. Logic programming is introduced as another way of declarative programming. The principles are demonstrated on lambda calculus and on Lisp (Racket) and Prolog programming languages. Moreover, usage of these principles is demonstrated on modern mainstream programming languages such as C++ and Java.</p>			
BIK-PRR.21	Project management	Z,ZK	5
<p>Project management not only as a common dictionary and setting necessary processes while preparing and / or managing projects, but also as a social art. 20 years of experience not only in IT in various positions and different projects available at your hands.</p>			
BIK-PSI.21	Computer Networks	Z,ZK	5
<p>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.</p>			
BIK-PST.21	Probability and Statistics	Z,ZK	5
<p>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.</p>			
BIK-SAP.21	Computer Structure and Architecture	Z,ZK	5
<p>Students will get acquainted with the basic architecture and units of a digital computer, understand the structure, function, and implementation of arithmetic-logic unit, controllers, memory, I/O communication, methods of data transfers between the units. The logic design and the implementation of a program-controlled simple processor is practically implemented in the labs using programmable circuits (FPGA), a single-chip microcomputer, and modern design (EDA) tools.</p>			
BIK-SIP.21	Network Programming	Z	5
<p>The course covers fundamental topics of programming network applications. It consists of 4 parts. The introductory part is focused on low-level programming using BSD sockets. The second part is devoted to designing communication protocols and their verification. The third part introduces the principles and applications of middleware technologies. The final part introduces basic modern models of distributed computing - P2P and blockchain. All topics will be first explained theoretically and then practices in computer labs using a chosen programming language environment.</p>			
BIK-SP1.21	Team Software Project 1	KZ	5
<p>Students gain hands-on experience with the analysis, design, and prototyping of a large-scale software system. Theoretical support is provided in the BIE-SWI course that runs concurrently and that teaches students necessary techniques and principles. Teams consisting of 4-6 students will work on a specific project. The teacher, in the role of the team and project leader, regularly consults with the team (at the seminars) both the formal and material aspects of the software design. The resulting software artefact will be further developed and finished in the BIE-SP2 course.</p>			
BIK-SP2.21	Team Software Project 2	KZ	5
<p>This course is presented in Czech. However, there is an English variant in the program Informatics (B1801 / 4753).</p>			

BIK-SPS.21	Administration of Computer Networks and Services	Z,ZK	5
The aim of the course is to deepen the theoretical knowledge of network technologies and protocols in the environment of network servers administrated under the operating systems Linux and Windows. The course syllabus requires the knowledge at the level of courses BIE-PSI, BIE-VPS, and BIE-OSY. Practical skills will be gained by practical hands-on experience with real network infrastructure.			
BIK-SQL.1	Language SQL	KZ	4
Course is based on knowledge obtained in BI-DBS. Students become familiar with advanced relational and non-relational features of SQL language. In particular stored program unites, triggers, recursive queries, OLAP support, object-relational constructions. Part of the course is dedicated to practical database optimization from the point of view of specialized database structures like indexes, clusters, index-organized tables, and materialized views. as well as from the point of view query optimization. Execution plan and possibilities of its. changes will be discussed. Lectures will usually discuss SQL standard, but many features will be demonstrated on Oracle DBMS. Seminars are based on Oracle DBMS and partially on PostgreSQL.			
BIK-STO	Storage and Filesystems	Z,ZK	4
The student will learn principles and current solutions of storage systems architecture. The module explains principles of data store, protection, and archiving, as so as storage scaling, load balancing and high availability.			
BIK-SWI.21	Software Engineering	Z,ZK	5
Students get acquainted with methods of analysis and design of larger software projects that are typically designed and implemented in teams. They consolidate and practically verify their knowledge during the analysis and design of larger software systems that will be developed in the concurrent course BIE-SP1. Students get hands-on experience with CASE tools using the visual language UML for modeling and solving software problems. Students learn the basics of object-oriented analysis, architecture design and testing. Within the course, students also gain a theoretical basis in the field of project management, estimation of costs of software projects, and methods of their development.			
BIK-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.			
BIK-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.			
BIK-TJV.21	Java Technology	Z,ZK	5
The aim of the course is to provide knowledge and skills needed for the development of smaller and larger information systems. Students will get acquainted with general theoretical concepts and will be able to apply these concepts using libraries and tools from the ecosystem of the Java programming language. After completing the course students will be able to participate in the development of software systems on the Java platform.			
BIK-TPS.21	Computer Networks Technologies	Z,ZK	5
The course introduces students with basic and advanced technologies, components, and interfaces of contemporary computer networks at the physical layer with the overlap to the link layer. The lectures provide theoretical foundations of these technologies and explain relevant physical principles. In the labs, the respective technologies will be demonstrated and with the most important ones students will get hands-on experience. Thematically, the course covers both local and long-range optical networks, Ethernet, modern wireless networks, always with focus on high-speed networks.			
BIK-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.			
BIK-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.			
BIK-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.			
BIK-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.			
BIK-VDC.21	Virtualization and Data Centers	Z,ZK	5
The aim of the course is to familiarize students with technology basis of cloud computer systems. It shows principles and techniques used in design and implementation of data center infrastructure, such as various kinds of virtualization and high availability of servers, storages, and software layers. The course guides through data center technologies from private to public and hybrid clouds. Student learn current trends in the architecture of IT infrastructure and its configuration for classic and cloud applications. Students will understand the design, validation, and operation of complex infrastructures for modern applications with respect to scalability and protection against overloads, outages, and data losses.			
BIK-VPS.21	Selected Topics in Computer Networking	Z,ZK	5
The course builds upon the Computer Networks course (BI-PSI), obligatory for the program. Students will learn in detail principles, protocols, and technologies used in modern computer networks from local area networks up to Internet, with focus on switching, routing, security, and virtualization. The emphasis will be on gaining practical experience with real network devices in the lab and learning important methods of local area and wide area networks from the viewpoint of functionality, performance, and security.			
BIK-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.			
BIK-ZWU	Introduction to Web and User Interfaces	Z,ZK	4
This course is presented in Czech.			

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

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