# Study plan

## Name of study plan: Design and Programming of Embedded Systems, in English, Version 2016 až 2020

Faculty/Institute/Others:
Department: Department of Digital Design
Branch of study guaranteed by the department: Design and Programming of Embedded Systems
Garantor of the study branch: doc. Ing. Hana Kubátová, CSc.
Program of study: Informatics (in English)
Type of study: Follow-up master full-time
Required credits: 93
Elective courses credits: 27
Sum of credits in the plan: 120
Note on the plan:

---

Name of the block: Compulsory courses in the program
Minimal number of credits of the block: 54
The role of the block: PP

---

Code of the group: MIE-PP.2016
Name of the group: Compulsory Courses od Master Study Program Informatics, Version 2016, in English
Requirement credits in the group: In this group you have to gain 54 credits
Requirement courses in the group: In this group you have to complete 6 courses
Credits in the group: 54
Note on the group: Opakovaně do studia zapsaní studenti s uznatelnou zkouškou z PAR mají uznanou zkoušku z předmětu PDP.

| 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 |
|---|---|---|---|---|---|---|
| MIE-DIP | **Diploma Project** ***Miroslav Balík*** *Zdeněk Muzikář (Gar.)* | Z | 23 | | Z,L | PP |
| MIE-MPR | **Master Project** *Zdeněk Muzikář* ***Miroslav Balík*** *Zdeněk Muzikář (Gar.)* | Z | 7 | | Z | PP |
| MIE-MPI | **Mathematics for Informatics** *Francesco Dolce, Štěpán Starosta Štěpán Starosta (Gar.)* | Z,ZK | 7 | 3P+1R+1C | Z | PP |
| MIE-PDP.16 | **Parallel and Distributed Programming** *Pavel Tvrdík* ***Pavel Tvrdík*** *Pavel Tvrdík (Gar.)* | Z,ZK | 5 | 2P+2C | L | PP |
| MIE-PAA | **Problems and Algorithms** *Petr Fišer* ***Petr Fišer*** *Petr Fišer (Gar.)* | Z,ZK | 5 | 2P+1R+1C | Z | PP |
| MIE-SPI.16 | **Statistics for Informatics** *Petr Novák* ***Petr Novák*** *Pavel Hrabák (Gar.)* | Z,ZK | 7 | 4P+2C | L | PP |

**Characteristics of the courses of this group of Study Plan: Code=MIE-PP.2016 Name=Compulsory Courses od Master Study Program Informatics, Version 2016, in English**

| | | | |
|---|---|---|---|
| MIE-DIP | Diploma Project | Z | 23 |
| MIE-MPR | Master Project | Z | 7 |

1. At the beginning of the semester, a student reserves her/his final thesis topic and gets together with its supervisor. Together they decide on partial tasks that should be carried out during the semester. If the requirements they agreed upon are met, the supervisor awards the student an assessment for the course MI-MPR at the end of the semester. 2. External Master these (MT) supervisor fills his/her assessment into the paper "Form to award assessment by an external Final theses (FT) supervisor" (for the courses BIE-BAP, MIE-MPR, MIE-DIP). Students, then, ensure that the assessment is registered into the information system (IS) by asking their internal FT opponent to award the assessment to the IS based on the confirmation of the external MT supervisor. In the case the FT opponent is external as well, the assessment will be registered to the IS by the head of the department responsible for the topic of the MT. 3. If the FT topic that the student has reserved is rather general, the immediate tasks the supervisor assigns to the student for the upcoming semester should aim at fine-tuning the FT topic so that the FTT will be complete and approvable at the end of the semester.

| | | | |
|---|---|---|---|
| MIE-MPI | Mathematics for Informatics | Z,ZK | 7 |

The course comprises topics from general algebra with focus on finite structures used in computer science. It includes topics from multi-variate analysis, smooth optimization and multi-variate integration. The third large topic is computer arithmetics and number representation in a computer along with error manipulation. The last topic includes selected numerical algorithm and their stability analysis. The topics are completed with demonstration of applications in computer science. The course focuses on clear presentation and argumentation.

| | | | |
|---|---|---|---|
| MIE-PDP.16 | Parallel and Distributed Programming | Z,ZK | 5 |

Due to the development of cloud, web, and communication technologies and due to the shift of the Moore law into parallelization of CPUs, parallel and distributed applications are becoming dominant. Students get acquainted with architectures of parallel and distributed computing systems and their models and with languages and environments for their programming. They learn the pattern designs for parallel and distributed programming and important parallel algorithms.

| | | | |
|---|---|---|---|
| MIE-PAA | Problems and Algorithms | Z,ZK | 5 |
| Students are able to evaluate discrete problems by complexity and by the purpose of optimisation (on-line tasks, multicriterial optimisation). They understand principles and properties of heuristics and exact algorithms and, therefore, are able to select, apply, and experimentally evaluate a suitable heuristics for a practical problem. | | | |
| MIE-SPI.16 | Statistics for Informatics | Z,ZK | 7 |
| The students will learn the basics of the probability theory, elements of information theory and stochastic processes, and some methods of computational statistics. They will understand the methods for statistical processing of large volumes of data. They will get skills in using computational methods and statistical software for these tasks. | | | |

Name of the block: Compulsory courses of the specialization
Minimal number of credits of the block: 35
The role of the block: PO

Code of the group: MIE-PO-NPVS.2016
Name of the group: Compulsory Courses of Master Branch Design and Programming of Embedded Systems, in English, 2016
Requirement credits in the group: In this group you have to gain 35 credits
Requirement courses in the group: In this group you have to complete 7 courses
Credits in the group: 35
Note on the group:

| Code | Name of the course / Name of the group of courses<br>*(in case of groups of courses the list of codes of their members)*<br>*Tutors,* ***authors*** *and guarantors (gar.)* | Completion | Credits | Scope | Semester | Role |
|---|---|---|---|---|---|---|
| MIE-NFA.16 | **Design for the FPGA and ASIC Technology**<br>*Jan Schmidt* ***Jan Schmidt*** *Jan Schmidt (Gar.)* | Z,ZK | 5 | 2P+1C | Z | PO |
| MIE-SIM.16 | **Digital Circuit Simulation**<br>*Martin Kohlík, Jiří Douša* ***Martin Kohlík*** *Martin Kohlík (Gar.)* | Z,ZK | 5 | 2P+1C | Z | PO |
| MIE-BKO.16 | **Error Control Codes**<br>*Pavel Kubalík* ***Pavel Kubalík*** *Pavel Kubalík (Gar.)* | Z,ZK | 5 | 2P+1C | L | PO |
| MIE-BHW.16 | **Security and Hardware**<br>*Martin Novotný* ***Martin Novotný*** *Martin Novotný (Gar.)* | Z,ZK | 5 | 2P+2C | L | PO |
| MIE-TES.16 | **Systems Theory**<br>*Stefan Ratschan, Tomáš Kolárik* ***Stefan Ratschan*** *Stefan Ratschan (Gar.)* | Z,ZK | 5 | 2P+1C | Z | PO |
| MIE-SOC.16 | **Systems on Chip**<br>*Hana Kubátová* ***Hana Kubátová*** *Hana Kubátová (Gar.)* | Z,ZK | 5 | 2P+1C | Z | PO |
| MIE-TSP.16 | **Testing and Reliability**<br>***Petr Fišer*** | Z,ZK | 5 | 2P+2C | Z | PO |

**Characteristics of the courses of this group of Study Plan: Code=MIE-PO-NPVS.2016 Name=Compulsory Courses of Master Branch Design and Programming of Embedded Systems, in English, 2016**

| | | | |
|---|---|---|---|
| MIE-NFA.16 | Design for the FPGA and ASIC Technology | Z,ZK | 5 |
| Students gain the basic knowledge needed to start a career in a design house. They will understand the FPGA and ASIC implementation technologies and the limitations that the technologies impose on the design. They are able to perform and to manage typical workflows, their analytic and synthetic steps, with an emphasis on basic verification. They know the structure and demands of software tools, as well as what to expect from them. | | | |
| MIE-SIM.16 | Digital Circuit Simulation | Z,ZK | 5 |
| Students gain information regarding the usage of basic tools for the design and simulation of VLSI (very large scale integration) digital circuits (VHDL, Verilog). They also get some knowledge about advanced tools System Verilog & SystemC. | | | |
| MIE-BKO.16 | Error Control Codes | Z,ZK | 5 |
| The goal of the course is to present various ways to detect or correct individual errors and burst errors in data stored into memories or transmitted via channels. | | | |
| MIE-BHW.16 | Security and Hardware | Z,ZK | 5 |
| Students gain a basic knowledge in selected topics of cryptography and cryptanalysis. The module focuses particularly on elliptic curve cryptography, and on contemporary attacks on cryptographic systems. Students gain a good overview of the functionality of (hardware) cryptographic accelerators, random number generators, smart cards, and resources for securing of internal functions of computer systems. | | | |
| MIE-TES.16 | Systems Theory | Z,ZK | 5 |
| Today, humankind has the ability to develop systems of incredible complexity (e.g., trains, microprocessors, airplanes, nuclear power plants). However, the costs of managing this complexity and of ensuring the correct behavior of a given system have become critical. A key technique for mastering this complexity is the usage of models that describe only those aspects of the systems that are important for the task at hand, and automated tools for analyzing those models. This subject will present theory and algorithms that form the basis for the modeling and analysis of complex systems. | | | |
| MIE-SOC.16 | Systems on Chip | Z,ZK | 5 |
| Students gain key knowledge and skills in the design of large-scale digital systems. They will be familiar with architectures of such systems and communication among their parts. They will use an appropriate workflow to design these architectures, their hardware and software. They will also have knowledge of contemporary methods of large systems verification and fault-tolerant systems design. | | | |
| MIE-TSP.16 | Testing and Reliability | Z,ZK | 5 |
| Students gain knowledge about circuit testing and about methods for increasing reliability and security. They will get practical skills to be able to prepare a test set with the help of the intuitive path sensitization and to use an ATPG for automatic test generation. They will be able to design easy testable circuits and systems with built-in-self-test equipment. They will be able to analyze and control reliability and availability of the designed circuits. | | | |

Name of the block: Compulsory elective economic-management courses
Minimal number of credits of the block: 2

The role of the block: VE

---

Code of the group: MIE-PV-EM.2016
Name of the group: Compulsory Elective Master Economics and Management Courses , in English, Ver. 2016
Requirement credits in the group: In this group you have to gain at least 2 credits (at most 6)
Requirement courses in the group: In this group you have to complete at least 1 course ( at most 2)
Credits in the group: 2
Note on the group: Opakovaně do studia zapsaným studentům: Má-li student uznaný předmět PRM, nelze ho uznat jako náhradu za nový předmět PCM (student musí vypracovat projekt).

| 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 |
|---|---|---|---|---|---|---|
| MIE-IBE | **Information Security** *Igor Čermák **Igor Čermák** Igor Čermák (Gar.)* | ZK | 2 | 2P | Z | VE |
| MIE-SEP | **World Economy and Business** *Jitka Evanová, Tomáš Evan **Jitka Evanová** Tomáš Evan (Gar.)* | Z,ZK | 4 | 2P+1C | Z | VE |

**Characteristics of the courses of this group of Study Plan: Code=MIE-PV-EM.2016 Name=Compulsory Elective Master Economics and Management Courses , in English, Ver. 2016**

| | | | |
|---|---|---|---|
| MIE-IBE | Information Security | ZK | 2 |
| Students learn information and IS/ICT security management systems (ISMS), methods for information access control, and basic norms and international standards in this area. They understand methods for management of internal and external security threats, for IS/IT security audits, and for application security testing (e.g., penetration testing). | | | |
| MIE-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. | | | |

---

Name of the block: Compulsory elective humanities courses
Minimal number of credits of the block: 2
The role of the block: VH

---

Code of the group: MIE-PV-HU.2016
Name of the group: Compulsory Elective Master Humanity Courses, Inclusive of Non-garanted Courses, Ver. 2016, English
Requirement credits in the group: In this group you have to gain at least 2 credits (at most 5)
Requirement courses in the group: In this group you have to complete at least 1 course ( at most 2)
Credits in the group: 2
Note on the group: If a student has attended one of the hum. courses offered here in bc. study, he must choose another

| 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 |
|---|---|---|---|---|---|---|
| MIE-KYB.16 | **Cybernality** ***Miroslav Balík*** | ZK | 5 | 2P | Z | VH |
| MIE-HMI | **History of Mathematics and Informatics** *Alena Šolcová **Alena Šolcová** Alena Šolcová (Gar.)* | Z,ZK | 3 | 2P+1C | Z | VH |

**Characteristics of the courses of this group of Study Plan: Code=MIE-PV-HU.2016 Name=Compulsory Elective Master Humanity Courses, Inclusive of Non-garanted Courses, Ver. 2016, English**

| | | | |
|---|---|---|---|
| MIE-KYB.16 | Cybernality | ZK | 5 |
| Students get acquainted with the fundamentals of legislation and international activities in the area of fighting cybercrime. Students will understand the classification of attacks and have an overview of systems for computer surveillance and traffic monitoring in the cyberspace. Students will also familiarize themselves with hacker activities and behavior. The course will also discuss the cooperation of the state agencies and subjects dealing with defence of the cyberspace (especially CSIRT and CERT teams). | | | |
| MIE-HMI | History of Mathematics and Informatics | Z,ZK | 3 |
| The course focuses on selected topics from calculus, general algebra, number theory, numerical mathematics and logic - useful for today computer science The topics are selected for finding some relations between computer science and mathematical methods. Some examples of applications of mathematics to computer sciences will be showed. | | | |

---

Name of the block: Elective courses
Minimal number of credits of the block: 0
The role of the block: V

---

Code of the group: MIE-NPVS-VO.2017
Name of the group: Elective Vocational Courses for Master Branch MIE-NPVS
Requirement credits in the group:
Requirement courses in the group:
Credits in the group: 0
Note on the group: Compusory courses of all branches and specialisations withnout branch MIE-NPVS

| 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 |
|---|---|---|---|---|---|---|
| MIE-POA.16 | **Advanced Computer System Architectures** *Pavel Tvrdík, Jiří Kašpar* ***Pavel Tvrdík*** *Pavel Tvrdík (Gar.)* | Z,ZK | 5 | 2P+1C | L | v |
| MIE-KRY.16 | **Advanced Cryptology** *Jiří Buček, Róbert Lórencz* ***Jiří Buček*** *Róbert Lórencz (Gar.)* | Z,ZK | 5 | 2P+2C | Z | v |
| MIE-PDB.16 | **Advanced Database Systems** *Martin Svoboda* ***Michal Valenta*** *Michal Valenta (Gar.)* | Z,ZK | 5 | 2P+1C | Z | v |
| MIE-PIS.16 | **Advanced Information Systems** *Petr Špaček, Petr Kroha* ***Petr Špaček*** *Petr Kroha (Gar.)* | Z,ZK | 5 | 2P+1C | L | v |
| MIE-ADP.16 | **Architecture and Design Patterns** *Petr Špaček* ***Petr Špaček*** *Petr Špaček (Gar.)* | Z,ZK | 5 | 2P+1C | Z | v |
| MIE-DSV.16 | **Distributed Systems and Computing** *Jan Janeček, Peter Macejko* ***Peter Macejko*** *Jan Janeček (Gar.)* | Z,ZK | 5 | 2P+1C | Z | v |
| MIE-FME.16 | **Formal Methods and Specifications** *Stefan Ratschan* ***Stefan Ratschan*** *Stefan Ratschan (Gar.)* | Z,ZK | 5 | 2P+1C | L | v |
| MIE-HWB.16 | **Hardware Security** *Jiří Buček, Róbert Lórencz* ***Jiří Buček*** *Róbert Lórencz (Gar.)* | Z,ZK | 5 | 2P+2C | L | v |
| MIE-MKY.16 | **Mathematics for Cryptology** *Martin Jureček, Čestmír Burdík Čestmír Burdík (Gar.)* | Z,ZK | 5 | 3P+1C | L | v |
| MIE-MTI.16 | **Modern Internet Technologies** *Viktor Černý, Alexandru Moucha* ***Alexandru Moucha*** *Alexandru Moucha (Gar.)* | Z,ZK | 5 | 2P+1C | Z | v |
| MIE-SIB.16 | **Network Security** *Simona Buchovecká, Tomáš Čejka* ***Tomáš Čejka*** *Simona Buchovecká (Gar.)* | Z,ZK | 5 | 2P+1C | Z | v |
| MI-NSS.16 | **Normalized Software Systems** *Jan Verelst, Robert Pergl, Marek Suchánek* ***Robert Pergl*** *Jan Verelst (Gar.)* | ZK | 5 | 2P | L | v |
| MIE-PAP.16 | **Parallel Computer Architectures** *Ivan Šimeček* ***Ivan Šimeček*** *Ivan Šimeček (Gar.)* | Z,ZK | 5 | 2P+1C | L | v |
| MIE-REV.16 | **Reverse Engineering** *Josef Kokeš Róbert Lórencz (Gar.)* | Z,ZK | 5 | 1P+2C | Z | v |
| MIE-SYB.16 | **System Security** *Jiří Buček, Róbert Lórencz, Simona Buchovecká, Jiří Smítka* ***Simona Buchovecká*** *Róbert Lórencz (Gar.)* | Z,ZK | 5 | 2P+2C | L | v |
| MIE-NUR.16 | **User Interface Design** *Pavel Žikovský* ***Pavel Žikovský*** *Pavel Žikovský (Gar.)* | Z,ZK | 5 | 2P+1C | Z | v |
| MIE-MDW.16 | **Web Services and Middleware** *Milan Dojčinovski* ***Tomáš Vitvar*** *Tomáš Vitvar (Gar.)* | Z,ZK | 5 | 2P+1C | Z | v |

**Characteristics of the courses of this group of Study Plan: Code=MIE-NPVS-VO.2017 Name=Elective Vocational Courses for Master Branch MIE-NPVS**

| | | | |
|---|---|---|---|
| MIE-POA.16 | Advanced Computer System Architectures | Z,ZK | 5 |
| The student will learn the current trends in infrastructure architecture of complex business computer systems. After completion of the module, the student will be able to design a complex system infrastructure that meets availability and scalability requirements given by the business environment. | | | |
| MIE-KRY.16 | Advanced Cryptology | Z,ZK | 5 |
| Students will learn the essentials of cryptanalysis and the mathematical principles of constructing symmetric and asymmetric ciphers. They will know the mathematical principles of random number generators. They will have an overview of cryptanalysis methods, elliptic curve cryptography and quantum cryptography, which they can apply to the integration of their own systems or to the creation of their own software solutions. | | | |
| MIE-PDB.16 | Advanced Database Systems | Z,ZK | 5 |
| Students will get an overview of SQL application debugging and tuning. They will know the methods for evaluation and optimisation which are common to all DB engines. Students will also have the knowledge necessary to design distributed DB systems. They will understand the area of conceptual design of data warehouses. | | | |
| MIE-PIS.16 | Advanced Information Systems | Z,ZK | 5 |
| Students learn the notion of business process logic and its formalization, with business process roles, business rules, and data processing, with the notion of service oriented company, enterprise services and service solution of business logic. They get acquainted with these notions also for the other types of ISs. They learn about agility and adaptivity and using of artificial intelligence methods for implementation of these ideas in ISs. They understand modern object-oriented methodologies for modelling of business processes, business rules, processed data, and enterprise ISs. They will get the rules and technologies for successful implementation of IS. | | | |
| MIE-ADP.16 | Architecture and Design Patterns | Z,ZK | 5 |
| The objective of this course is to provide students with both work knowledge about the underlying foundations of object-oriented design and analysis as well as with understanding of the challenges, issues, and tradeoffs of advanced software design. In the first part of the course, the students will refresh and deepen their knowledge of object-oriented programming and get familiar with the commonly used object-oriented design patterns that represent the best practices for solving common software design problems. In the second part the students will be introduced to the principles of software architecture design and analysis. This includes the classical architectural styles, component based systems, and some advanced software architectures used in large-scale distributed systems. | | | |

| | | | |
|---|---|---|---|
| MIE-DSV.16 | Distributed Systems and Computing | Z,ZK | 5 |
| Students are introduced to methods for coordination of processes in distributed environment characterised by nondeterministic time responses of computing processes and communication channels. They learn basic algorithms that assure correctness of computations realized by a group of loosely coupled processes and mechanisms that support high availability of both data and services, and safety in case of failures. | | | |
| MIE-FME.16 | Formal Methods and Specifications | Z,ZK | 5 |
| After the course, students will be able to describe semantics of software formally and to use sound reasoning for construction of correct software. They learn to use some software tools that allow to prove basic properties of software. | | | |
| MIE-HWB.16 | Hardware Security | Z,ZK | 5 |
| The course provides the knowledge needed for the analysis and design of computer systems security solutions. Students get an overview of safeguards against abuse of the system using hardware means. They will be able to safely use and integrate hardware components into systems and test them for resistance to attacks. Students will gain knowledge about the cryptographic accelerators, PUF, random number generators, smart cards, biometric devices, and devices for internal security functions of the computer. | | | |
| MIE-MKY.16 | Mathematics for Cryptology | Z,ZK | 5 |
| Students become familiar with parts of mathematics necessary for deeper understanding of the methods used in symmetric and asymmetric cryptography. They learn the mathematical principles on which security of encryption systems, cryptanalysis methods, cryptography over elliptic curves, and quantum cryptography are based. | | | |
| MIE-MTI.16 | Modern Internet Technologies | Z,ZK | 5 |
| Students learn technologies of the modern Internet. links of the IP technology to the modern communication networks, mechanisms for multicasting and real-time communication, more efficient mechanisms of virtual channels, and the new IPv6 architecture. They will understand the issues of monitoring and management of large computer networks. They are introduced to the technologies of interconnection networks for HPC systems. | | | |
| MIE-SIB.16 | Network Security | Z,ZK | 5 |
| The students will gain theoretical and practical experience with technologies and systems for detection of intrusions in large-scale high-speed networks. They will also learn basic concepts of statistical modeling of communication protocols. Students will also gain basic theoretical and practical skills required to perform realistic simulations of computer networks. They will also be introduced to basic psychological aspects of network security and the role of the human factor in attacks on information systems. | | | |
| MI-NSS.16 | Normalized Software Systems | ZK | 5 |
| Students will learn the foundations of Normalized Systems theory, which studies the evolvability of modular structures based on concepts from engineering such as stability from systems theory and entropy from thermodynamics. Initially, the theory was developed at the level of software architectures, where the concept of stability was translated into the definition of so-called combinatorial effects. These effects occur when the impact of a change to the software architecture is dependent on the change itself, as well as on the size of the system. The latter is highly undesirable, as it will cause even a simple change to incur an ever-increasing impact as the size of the system grows over time. As such, combinatorial effects can be considered as a main cause of Lehman?s Law of Increasing Complexity (see, e.g., http://en.wikipedia.org/wiki/Lehman's_laws_of_software_evolution). Additionally, the concept of entropy was used in the study of which micro-states in a modular structure correspond with a given macro-state. This is related mainly to issues such as testing in software architectures. Normalized Systems theory consists first of a set of principles which indicate where violations of stability and entropy-related issues occur in any given software architecture. These principles indicate that very fine-grained modular structures are required in order to control them. In the second part of the theoretical framework, it is shown how software architectures can be constructed based on a set of 5 design patterns called elements. These elements provide the core functionality of information systems in terms of storing data, executing actions, workflows, connectors and triggers, while controlling for violations of the stability and entropy-related principles, allowing them to realize new levels of evolvability in software architectures. Recently, Normalized Systems theory was also applied to the modular structures in business processes and enterprise architectures, with the goal of constructing a foundational theory for Enterprise Engineering. | | | |
| MIE-PAP.16 | Parallel Computer Architectures | Z,ZK | 5 |
| The students gain a good overview of present parallel architectures and processors:parallel (ILP) microarchitectures, multithreaded and multicore processors, SoCs and MPSoCs, GPUs, and neural processors. Students also get hands-on experience with programming these systems. | | | |
| MIE-REV.16 | Reverse Engineering | Z,ZK | 5 |
| Students will get acquainted with the essentials of reverse engineering of computer software. They will learn how processes start and what happens before and after the main function is called. Students will understand how executable files are organized and how they interact with 3rd party libraries. Another part of the course is dedicated to reverse engineering of applications written in C++. Students will also understand principles of disassemblers and obfuscation techniques. A part of the course will also be dedicated to debuggers: how debuggers and debugging work and which methods can be used to detect it. One of the lectures will be dedicated to the latest trends on the computer malware scene. The focus of the course is on the seminars, where students will solve practically oriented tasks from the real world. | | | |
| MIE-SYB.16 | System Security | Z,ZK | 5 |
| Students will familiarize themselves with the actual ICT security needs in all ICT disciplines. Students will gain knowledge of typical network attacks and protection against them, together with essential communication encryption techniques. They will learn how to work with certain aspects of encryption techniques - passwords and certificates. After that, students will learn the basics of anti-virus, anti-spam and heuristic analyses used in modern anti-virus solutions or Unified Threat Management (UTM) based solutions. They will also learn the principles of securing websites, web applications and databases. Upon completion of the module, students will have a broad overview of IT security and will be able to apply it to the integration of various software systems and applications. | | | |
| MIE-NUR.16 | User Interface Design | Z,ZK | 5 |
| Students will understand the theorical background of human-computer interaction and user interface (UI) design, will learn formal description of UIs, formal user models, the fundamental notions and procesures. They get acquainted with graphical, speech, and multimodal UIs. Thanks to the gained knowledge, the students will be able to design advanced UIs. | | | |
| MIE-MDW.16 | Web Services and Middleware | Z,ZK | 5 |
| Students learn new trends and technologies in the area of service-oriented architectures, web services, middleware, and cloud computing, including their theoretical background. | | | |

Code of the group: MIE-V.2017
Name of the group: Purely Elective Master Courses, version 2017
Requirement credits in the group:
Requirement courses in the group:
Credits in the group: 0
Note on the group:

| Code | **Name of the course / Name of the group of courses** ***(in case of groups of courses the list of codes of their members)*** *Tutors,* ***authors*** *and guarantors (gar.)* | Completion | Credits | Scope | Semester | Role |
|---|---|---|---|---|---|---|
| MIE-LCF | **Compiling system LLVM** | Z,ZK | 4 | | Z | V |
| MIE-ARI | **Computer Arithmetic** *Pavel Kubalík* ***Pavel Kubalík*** *Pavel Kubalík (Gar.)* | Z,ZK | 4 | 2P+1C | Z | V |

| | | | | | | |
|---|---|---|---|---|---|---|
| MIE-KOD.16 | **Data Compression**<br>*Jan Holub* ***Jan Holub*** *Jan Holub (Gar.)* | Z,ZK | 5 | 2P+1C | L | v |
| MI-GLR | **Games and reinforcement learning** | Z,ZK | 4 | 2P+2C | L | v |
| MIE-MZI | **Mathematics for data science**<br>***Štěpán Starosta*** | Z,ZK | 4 | 2P+1C | L | v |
| MIE-ROZ.16 | **Pattern Recognition** | Z,ZK | 5 | 2P+1C | Z | v |
| NIE-VPR | **Research Project**<br>***Štěpán Starosta*** *Štěpán Starosta (Gar.)* | Z | 5 | | Z,L | v |
| MI-SCE1 | **Computer Engineering Seminar Master I**<br>***Martin Novotný*** *Hana Kubátová (Gar.)* | Z | 4 | 2C | L,Z | v |
| MIE-BPS | **Wireless Computer Networks**<br>*Viktor Černý, Alexandru Moucha* ***Alexandru Moucha*** *Viktor Černý (Gar.)* | Z,ZK | 4 | 2P+1C | L | v |

**Characteristics of the courses of this group of Study Plan: Code=MIE-V.2017 Name=Purely Elective Master Courses, version 2017**

| | | | |
|---|---|---|---|
| MIE-LCF | Compiling system LLVM | Z,ZK | 4 |
| MIE-ARI | Computer Arithmetic | Z,ZK | 4 |
| Students will learn various data representations used in digital devices and will be able to design units realizing arithmetic operations. | | | |
| MIE-KOD.16 | Data Compression | Z,ZK | 5 |
| Students are introduced to the basic principles of data compression. They will learn the necessary theoretical background and get an overview of data compression methods being used in practice. The overview covers principles of integer coding and of statistical, dictionary, and context data compression methods. In addition, students learn the fundamentals of lossy data compression methods used in image, audio, and video compression. | | | |
| MI-GLR | Games and reinforcement learning | Z,ZK | 4 |
| The field of reinforcement learning is very hot recently, because of advances in deep learning, recurrent neural networks and general artificial intelligence. This course is intended to give you both theoretical and practical background so you can participate in related research activities. Presented in English. | | | |
| MIE-MZI | Mathematics for data science | Z,ZK | 4 |
| In this course, the students are introduced to the domains of mathematics necessary for understanding the standard methods and algorithms used in data science. The studied topics include mainly: linear algebra (matrix factorisations, eigenvalues, diagonalization), continuous optimisation (optimisation with constraints, duality principle, gradient methods) and selected notions from probability theory and statistics. | | | |
| MIE-ROZ.16 | Pattern Recognition | Z,ZK | 5 |
| The aim of the module is to give a systematic account of the major topics in pattern recognition with emphasis on problems and applications of the statistical approach to pattern recognition. Students will learn the fundamental concepts and methods of pattern recognition, including probability models, parameter estimation, and their numerical aspects. | | | |
| NIE-VPR | Research Project | Z | 5 |
| 1. At the beginning of the semester, a student reserves her/his final thesis topic and gets together with its supervisor. Together they decide on partial tasks that should be carried out during the semester. If the requirements they agreed upon are met, the supervisor awards the student an assessment for the course MI-MPR at the end of the semester. 2. External Master these (MT) supervisor fills his/her assessment into the paper "Form to award assessment by an external Final theses (FT) supervisor" (for the courses BIE-BAP, MIE-MPR, MIE-DIP). Students, then, ensure that the assessment is registered into the information system (IS) by asking their internal FT opponent to award the assessment to the IS based on the confirmation of the external MT supervisor. In the case the FT opponent is external as well, the assessment will be registered to the IS by the head of the department responsible for the topic of the MT. 3. If the FT topic that the student has reserved is rather general, the immediate tasks the supervisor assigns to the student for the upcoming semester should aim at fine-tuning the FT topic so that the FTT will be complete and approvable at the end of the semester. | | | |
| MI-SCE1 | Computer Engineering Seminar Master 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. | | | |
| MIE-BPS | Wireless Computer Networks | Z,ZK | 4 |
| Students will learn about the modern technologies, protocols, and standards for wireless networks. They will understand the routing mechanisms in ad-hoc networks, multicast and broadcast mechanisms, and data flow control mechanisms. They will also learn about principles of communication in sensor networks. They get knowledge of security mechanisms for wireless networks and get skills of configuration of wireless network elements and simulation of wireless networks using suitable tools. | | | |

## List of courses of this pass:

| Code | Name of the course | Completion | Credits |
|---|---|---|---|
| MI-GLR | Games and reinforcement learning | Z,ZK | 4 |
| The field of reinforcement learning is very hot recently, because of advances in deep learning, recurrent neural networks and general artificial intelligence. This course is intended to give you both theoretical and practical background so you can participate in related research activities. Presented in English. | | | |
| MI-NSS.16 | Normalized Software Systems | ZK | 5 |
| Students will learn the foundations of Normalized Systems theory, which studies the evolvability of modular structures based on concepts from engineering such as stability from systems theory and entropy from thermodynamics. Initially, the theory was developed at the level of software architectures, where the concept of stability was translated into the definition of so-called combinatorial effects. These effects occur when the impact of a change to the software architecture is dependent on the change itself, as well as on the size of the system. The latter is highly undesirable, as it will cause even a simple change to incur an ever-increasing impact as the size of the system grows over time. As such, combinatorial effects can be considered as a main cause of Lehman?s Law of Increasing Complexity (see, e.g., http://en.wikipedia.org/wiki/Lehman's_laws_of_software_evolution). Additionally, the concept of entropy was used in the study of which micro-states in a modular structure correspond with a given macro-state. This is related mainly to issues such as testing in software architectures. Normalized Systems theory consists first of a set of principles which indicate where violations of stability and entropy-related issues occur in any given software architecture. These principles indicate that very fine-grained modular structures are required in order to control them. In the second part of the theoretical framework, it is shown how software architectures can be constructed based on a set of 5 design patterns called elements. These elements provide the core functionality of information systems in terms of storing data, executing actions, workflows, connectors and triggers, while controlling for violations of the stability and entropy-related principles, allowing them to realize new levels of evolvability in software architectures. | | | |

Recently, Normalized Systems theory was also applied to the modular structures in business processes and enterprise architectures, with the goal of constructing a foundational theory for Enterprise Engineering.

| | | | |
|---|---|---|---|
| MI-SCE1 | Computer Engineering Seminar Master 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.

| | | | |
|---|---|---|---|
| MIE-ADP.16 | Architecture and Design Patterns | Z,ZK | 5 |

The objective of this course is to provide students with both work knowledge about the underlying foundations of object-oriented design and analysis as well as with understanding of the challenges, issues, and tradeoffs of advanced software design. In the first part of the course, the students will refresh and deepen their knowledge of object-oriented programming and get familiar with the commonly used object-oriented design patterns that represent the best practices for solving common software design problems. In the second part the students will be introduced to the principles of software architecture design and analysis. This includes the classical architectural styles, component based systems, and some advanced software architectures used in large-scale distributed systems.

| | | | |
|---|---|---|---|
| MIE-ARI | Computer Arithmetic | Z,ZK | 4 |

Students will learn various data representations used in digital devices and will be able to design units realizing arithmetic operations.

| | | | |
|---|---|---|---|
| MIE-BHW.16 | Security and Hardware | Z,ZK | 5 |

Students gain a basic knowledge in selected topics of cryptography and cryptanalysis. The module focuses particularly on elliptic curve cryptography, and on contemporary attacks on cryptographic systems. Students gain a good overview of the functionality of (hardware) cryptographic accelerators, random number generators, smart cards, and resources for securing of internal functions of computer systems.

| | | | |
|---|---|---|---|
| MIE-BKO.16 | Error Control Codes | Z,ZK | 5 |

The goal of the course is to present various ways to detect or correct individual errors and burst errors in data stored into memories or transmitted via channels.

| | | | |
|---|---|---|---|
| MIE-BPS | Wireless Computer Networks | Z,ZK | 4 |

Students will learn about the modern technologies, protocols, and standards for wireless networks. They will understand the routing mechanisms in ad-hoc networks, multicast and broadcast mechanisms, and data flow control mechanisms. They will also learn about principles of communication in sensor networks. They get knowledge of security mechanisms for wireless networks and get skills of configuration of wireless network elements and simulation of wireless networks using suitable tools.

| | | | |
|---|---|---|---|
| MIE-DIP | Diploma Project | Z | 23 |
| MIE-DSV.16 | Distributed Systems and Computing | Z,ZK | 5 |

Students are introduced to methods for coordination of processes in distributed environment characterised by nondeterministic time responses of computing processes and communication channels. They learn basic algorithms that assure correctness of computations realized by a group of loosely coupled processes and mechanisms that support high availability of both data and services, and safety in case of failures.

| | | | |
|---|---|---|---|
| MIE-FME.16 | Formal Methods and Specifications | Z,ZK | 5 |

After the course, students will be able to describe semantics of software formally and to use sound reasoning for construction of correct software. They learn to use some software tools that allow to prove basic properties of software.

| | | | |
|---|---|---|---|
| MIE-HMI | History of Mathematics and Informatics | Z,ZK | 3 |

The course focuses on selected topics from calculus, general algebra, number theory, numerical mathematics and logic - useful for today computer science The topics are selected for finding some relations between computer science and mathematical methods. Some examples of applications of mathematics to computer sciences will be showed.

| | | | |
|---|---|---|---|
| MIE-HWB.16 | Hardware Security | Z,ZK | 5 |

The course provides the knowledge needed for the analysis and design of computer systems security solutions. Students get an overview of safeguards against abuse of the system using hardware means. They will be able to safely use and integrate hardware components into systems and test them for resistance to attacks. Students will gain knowledge about the cryptographic accelerators, PUF, random number generators, smart cards, biometric devices, and devices for internal security functions of the computer.

| | | | |
|---|---|---|---|
| MIE-IBE | Information Security | ZK | 2 |

Students learn information and IS/ICT security management systems (ISMS), methods for information access control, and basic norms and international standards in this area. They understand methods for management of internal and external security threats, for IS/IT security audits, and for application security testing (e.g., penetration testing).

| | | | |
|---|---|---|---|
| MIE-KOD.16 | Data Compression | Z,ZK | 5 |

Students are introduced to the basic principles of data compression. They will learn the necessary theoretical background and get an overview of data compression methods being used in practice. The overview covers principles of integer coding and of statistical, dictionary, and context data compression methods. In addition, students learn the fundamentals of lossy data compression methods used in image, audio, and video compression.

| | | | |
|---|---|---|---|
| MIE-KRY.16 | Advanced Cryptology | Z,ZK | 5 |

Students will learn the essentials of cryptanalysis and the mathematical principles of constructing symmetric and asymmetric ciphers. They will know the mathematical principles of random number generators. They will have an overview of cryptanalysis methods, elliptic curve cryptography and quantum cryptography, which they can apply to the integration of their own systems or to the creation of their own software solutions.

| | | | |
|---|---|---|---|
| MIE-KYB.16 | Cybernality | ZK | 5 |

Students get acquainted with the fundamentals of legislation and international activities in the area of fighting cybercrime. Students will understand the classification of attacks and have an overview of systems for computer surveillance and traffic monitoring in the cyberspace. Students will also familiarize themselves with hacker activities and behavior. The course will also discuss the cooperation of the state agencies and subjects dealing with defence of the cyberspace (especially CSIRT and CERT teams).

| | | | |
|---|---|---|---|
| MIE-LCF | Compiling system LLVM | Z,ZK | 4 |
| MIE-MDW.16 | Web Services and Middleware | Z,ZK | 5 |

Students learn new trends and technologies in the area of service-oriented architectures, web services, middleware, and cloud computing, including their theoretical background.

| | | | |
|---|---|---|---|
| MIE-MKY.16 | Mathematics for Cryptology | Z,ZK | 5 |

Students become familiar with parts of mathematics necessary for deeper understanding of the methods used in symmetric and asymmetric cryptography. They learn the mathematical principles on which security of encryption systems, cryptanalysis methods, cryptography over elliptic curves, and quantum cryptography are based.

| | | | |
|---|---|---|---|
| MIE-MPI | Mathematics for Informatics | Z,ZK | 7 |

The course comprises topics from general algebra with focus on finite structures used in computer science. It includes topics from multi-variate analysis, smooth optimization and multi-variate integration. The third large topic is computer arithmetics and number representation in a computer along with error manipulation. The last topic includes selected numerical algorithm and their stability analysis. The topics are completed with demonstration of applications in computer science. The course focuses on clear presentation and argumentation.

| | | | |
|---|---|---|---|
| MIE-MPR | Master Project | Z | 7 |

1. At the beginning of the semester, a student reserves her/his final thesis topic and gets together with its supervisor. Together they decide on partial tasks that should be carried out during the semester. If the requirements they agreed upon are met, the supervisor awards the student an assessment for the course MI-MPR at the end of the semester. 2. External Master these (MT) supervisor fills his/her assessment into the paper "Form to award assessment by an external Final theses (FT) supervisor" (for the courses BIE-BAP, MIE-MPR, MIE-DIP). Students, then, ensure that the assessment is registered into the information system (IS) by asking their internal FT opponent to award the assessment to the IS based on the confirmation of the external MT supervisor. In the case the FT opponent is external as well, the assessment will be registered to the IS by the head of the department responsible

| | | | |
|---|---|---|---|
| | for the topic of the MT. 3. If the FT topic that the student has reserved is rather general, the immediate tasks the supervisor assigns to the student for the upcoming semester should aim at fine-tuning the FT topic so that the FTT will be complete and approvable at the end of the semester. | | |
| MIE-MTI.16 | Modern Internet Technologies | Z,ZK | 5 |
| | Students learn technologies of the modern Internet. links of the IP technology to the modern communication networks, mechanisms for multicasting and real-time communication, more efficient mechanisms of virtual channels, and the new IPv6 architecture. They will understand the issues of monitoring and management of large computer networks. They are introduced to the technologies of interconnection networks for HPC systems. | | |
| MIE-MZI | Mathematics for data science | Z,ZK | 4 |
| | In this course, the students are introduced to the domains of mathematics necessary for understanding the standard methods and algorithms used in data science. The studied topics include mainly: linear algebra (matrix factorisations, eigenvalues, diagonalization), continuous optimisation (optimisation with constraints, duality principle, gradient methods) and selected notions from probability theory and statistics. | | |
| MIE-NFA.16 | Design for the FPGA and ASIC Technology | Z,ZK | 5 |
| | Students gain the basic knowledge needed to start a career in a design house. They will understand the FPGA and ASIC implementation technologies and the limitations that the technologies impose on the design. They are able to perform and to manage typical workflows, their analytic and synthetic steps, with an emphasis on basic verification. They know the structure and demands of software tools, as well as what to expect from them. | | |
| MIE-NUR.16 | User Interface Design | Z,ZK | 5 |
| | Students will understand the theorical background of human-computer interaction and user interface (UI) design, will learn formal description of UIs, formal user models, the fundamental notions and procesures. They get acquainted with graphical, speech, and multimodal UIs. Thanks to the gained knowledge, the students will be able to design advanced UIs. | | |
| MIE-PAA | Problems and Algorithms | Z,ZK | 5 |
| | Students are able to evaluate discrete problems by complexity and by the purpose of optimisation (on-line tasks, multicriterial optimisation). They understand principles and properties of heuristics and exact algorithms and, therefore, are able to select, apply, and experimentally evaluate a suitable heuristics for a practical problem. | | |
| MIE-PAP.16 | Parallel Computer Architectures | Z,ZK | 5 |
| | The students gain a good overview of present parallel architectures and processors:parallel (ILP) microarchitectures, multithreaded and multicore processors, SoCs and MPSoCs, GPUs, and neural processors. Students also get hands-on experience with programming these systems. | | |
| MIE-PDB.16 | Advanced Database Systems | Z,ZK | 5 |
| | Students will get an overview of SQL application debugging and tuning. They will know the methods for evaluation and optimisation which are common to all DB engines. Students will also have the knowledge necessary to design distributed DB systems. They will understand the area of conceptual design of data warehouses. | | |
| MIE-PDP.16 | Parallel and Distributed Programming | Z,ZK | 5 |
| | Due to the development of cloud, web, and communication technologies and due to the shift of the Moore law into parallelization of CPUs, parallel and distributed applications are becoming dominant. Students get acquainted with architectures of parallel and distributed computing systems and their models and with languages and environments for their programming. They learn the pattern designs for parallel and distributed programming and important parallel algorithms. | | |
| MIE-PIS.16 | Advanced Information Systems | Z,ZK | 5 |
| | Students learn the notion of business process logic and its formalization, with business process roles, business rules, and data processing, with the notion of service oriented company, enterprise services and service solution of business logic. They get acquainted with these notions also for the other types of ISs. They learn about agility and adaptivity and using of artificial intelligence methods for implementation of these ideas in ISs. They understand modern object-oriented methodologies for modelling of business processes, business rules, processed data, and enterprise ISs. They will get the rules and technologies for successful implementation of IS. | | |
| MIE-POA.16 | Advanced Computer System Architectures | Z,ZK | 5 |
| | The student will learn the current trends in infrastructure architecture of complex business computer systems. After completion of the module, the student will be able to design a complex system infrastructure that meets availability and scalability requirements given by the business environment. | | |
| MIE-REV.16 | Reverse Engineering | Z,ZK | 5 |
| | Students will get acquainted with the essentials of reverse engineering of computer software. They will learn how processes start and what happens before and after the main function is called. Students will understand how executable files are organized and how they interact with 3rd party libraries. Another part of the course is dedicated to reverse engineering of applications written in C++. Students will also understand principles of disassemblers and obfuscation techniques. A part of the course will also be dedicated to debuggers: how debuggers and debugging work and which methods can be used to detect it. One of the lectures will be dedicated to the latest trends on the computer malware scene. The focus of the course is on the seminars, where students will solve practically oriented tasks from the real world. | | |
| MIE-ROZ.16 | Pattern Recognition | Z,ZK | 5 |
| | The aim of the module is to give a systematic account of the major topics in pattern recognition with emphasis on problems and applications of the statistical approach to pattern recognition. Students will learn the fundamental concepts and methods of pattern recognition, including probability models, parameter estimation, and their numerical aspects. | | |
| MIE-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. | | |
| MIE-SIB.16 | Network Security | Z,ZK | 5 |
| | The students will gain theoretical and practical experience with technologies and systems for detection of intrusions in large-scale high-speed networks. They will also learn basic concepts of statistical modeling of communication protocols. Students will also gain basic theoretical and practical skills required to perform realistic simulations of computer networks. They will also be introduced to basic psychological aspects of network security and the role of the human factor in attacks on information systems. | | |
| MIE-SIM.16 | Digital Circuit Simulation | Z,ZK | 5 |
| | Students gain information regarding the usage of basic tools for the design and simulation of VLSI (very large scale integration) digital circuits (VHDL, Verilog). They also get some knowledge about advanced tools System Verilog & SystemC. | | |
| MIE-SOC.16 | Systems on Chip | Z,ZK | 5 |
| | Students gain key knowledge and skills in the design of large-scale digital systems. They will be familiar with architectures of such systems and communication among their parts. They will use an appropriate workflow to design these architectures, their hardware and software. They will also have knowledge of contemporary methods of large systems verification and fault-tolerant systems design. | | |
| MIE-SPI.16 | Statistics for Informatics | Z,ZK | 7 |
| | The students will learn the basics of the probability theory, elements of information theory and stochastic processes, and some methods of computational statistics. They will understand the methods for statistical processing of large volumes of data. They will get skills in using computational methods and statistical software for these tasks. | | |
| MIE-SYB.16 | System Security | Z,ZK | 5 |
| | Students will familiarize themselves with the actual ICT security needs in all ICT disciplines. Students will gain knowledge of typical network attacks and protection against them, together with essential communication encryption techniques. They will learn how to work with certain aspects of encryption techniques - passwords and certificates. After that, students will learn the basics of anti-virus, anti-spam and heuristic analyses used in modern anti-virus solutions or Unified Threat Management (UTM) based solutions. They will also learn the principles of securing websites, web applications and databases. Upon completion of the module, students will have a broad overview of IT security and will be able to apply it to the integration of various software systems and applications. | | |

| | | | |
|---|---|---|---|
| MIE-TES.16 | Systems Theory | Z,ZK | 5 |
| Today, humankind has the ability to develop systems of incredible complexity (e.g., trains, microprocessors, airplanes, nuclear power plants). However, the costs of managing this complexity and of ensuring the correct behavior of a given system have become critical. A key technique for mastering this complexity is the usage of models that describe only those aspects of the systems that are important for the task at hand, and automated tools for analyzing those models. This subject will present theory and algorithms that form the basis for the modeling and analysis of complex systems. | | | |
| MIE-TSP.16 | Testing and Reliability | Z,ZK | 5 |
| Students gain knowledge about circuit testing and about methods for increasing reliability and security. They will get practical skills to be able to prepare a test set with the help of the intuitive path sensitization and to use an ATPG for automatic test generation. They will be able to design easy testable circuits and systems with built-in-self-test equipment. They will be able to analyze and control reliability and availability of the designed circuits. | | | |
| NIE-VPR | Research Project | Z | 5 |
| 1. At the beginning of the semester, a student reserves her/his final thesis topic and gets together with its supervisor. Together they decide on partial tasks that should be carried out during the semester. If the requirements they agreed upon are met, the supervisor awards the student an assessment for the course MI-MPR at the end of the semester. 2. External Master these (MT) supervisor fills his/her assessment into the paper "Form to award assessment by an external Final theses (FT) supervisor" (for the courses BIE-BAP, MIE-MPR, MIE-DIP). Students, then, ensure that the assessment is registered into the information system (IS) by asking their internal FT opponent to award the assessment to the IS based on the confirmation of the external MT supervisor. In the case the FT opponent is external as well, the assessment will be registered to the IS by the head of the department responsible for the topic of the MT. 3. If the FT topic that the student has reserved is rather general, the immediate tasks the supervisor assigns to the student for the upcoming semester should aim at fine-tuning the FT topic so that the FTT will be complete and approvable at the end of the semester. | | | |

For updated information see http://bilakniha.cvut.cz/en/FF.html
Generated: day 30. 03. 2020, time 01:43.