Dependable Systems International Research and Educational Experience
Brno University of Technology
Mobility Student Advertisement with course selection for Spring 2009

Sponsoring Unit:	Faculty of Information Technology Brno University of Technology Božetěchova 2 612 66 Brno, Czech Republic Web: http://www.fit.vutbr.cz/
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Academic Calendar:	02/09/2009 – 05/08/2009 spring term (13 weeks) 05/11/2009 – 05/29/2009 final examination period (3 weeks)
Holidays:	Monday 04/13/2009 Easter Friday 05/01/2009 Labour Day Friday 05/08/2009 Liberation Day (1945)
Academic Program:	The two-year follow-up Master study programme in Information Technology offers courses, in which the graduates gain deeper theoretical knowledge in their specialization. To graduate from the follow-up Master study programme students have to complete successfully courses worth 120 credits in a prescribed credit structure, produce and defend a MSc. thesis, and pass the verbal part of the Final State Examination. The prerequisites for the admission to the follow-up Master study programme is a completed Bachelor or Master study programme at a university certified by a diploma.
Courses Offered:	**SVS: Embedded System Specification, 5 ECTS** **Annotation:** Embedded distributed system design principles. Reactive systems and real-time systems. Reactive system and real-time system models. Fairness, livness, safety, feasibility; real-time livness. Temporal logic fundamentals. Time models and temporal logics. Temporal logic and real time. Formal specifications of embedded systems. Hybrid systems. Provers. Model checking. Real-time systems verification. **Prerequisites:** Propositional logic. Basics of the first-order logic. The elementary notions of communication protocols. **POS: Advanced Operating Systems, 5 ECTS** **Annotation:** Basic concepts, operating system kernel, kernel structure. Parallel programming and synchronization with a view to kernel synchronization. Deadlock, deadlock detection and prevention. Scheduling algorithms for uniprocessor systems. Memory management, virtual memory, paging, virtual memory implementation. Input/Output, synchronous and asynchronous I/O, drivers, optimalization of disk operations, File systems, disk space allocation, metadata structures, failure recovery, file system examples. Security and protection. **Prerequisites:** C language programming in Unix environment, computer architecture, Intel x86 assembler, basic principles of operating systems. **KKO: Data Coding and Compression, 5 ECTS**

	Annotation: Introduction to data compression theory. Lossy and lossless data compression, adaptive methods, statistical - Huffman and arithmetic coding, dictionary methods LZ77, 78, transform coding, Burrows-Wheeler transform. Hardware support for data compression. **Prerequisites:** Knowledge of functioning of basic computer units. **VNV: High Performance Computing** **Annotation:** Methodology of sequential and parallel computation (feedback stability of parallel computations). Extremely precise solutions of differential equations by the Taylor series method. Parallel properties of the Taylor series method. Basic programming of specialised parallel problems by methods using the calculus (close relationship of equation and block description). Parallel solutions of ordinary differential equations with constant coefficients, library subroutines for precise computations. Adjunct differential operators and parallel solutions of differential equations with variable coefficients. Methods of solution of large systems of algebraic equations by transforming them into ordinary differential equations. The Bairstow method for finding the roots of high-order algebraic equations. Fourier series and parallel FFT. Control circuits. Conception of the elementary processor of a specialised parallel computation system. **Prerequisites:** Basic lectures of mathematics at technical universities. **DBS: Diagnosis and Safe Systems, 5 ECTS** **Annotation:** Principles of fault tolerance, structures and techniques. Codes for control and correction of information. Test generation approaches. Funkctional tests. Sequential circuit testing. Test generation at RTL level. Random and pseudorandom test generation. Location sequences. Fault dictionaries. Diagnostic data compression. Design for testability. Built-in diagnosis. Memory testing. Processor and wiring testing. Fail-safe circuits. Fault-tolerance priciples. Diagnostic equipment. **Prerequisites:** Principles of computer organization. **SEP: Term Project, 5ECTS** **Annotation:** The fundamental goal of this course is to support the individual creative student work during the engineering project solving, its formal description, and defense.
Special Conditions:	Arrival of the students is considered 1 week before the start of each semester, i.e. in the summer semester from February 2, 2009 (Rector Direction). Later arrivals can cause some problems in the enrolled courses, because the teachers have no duty to supply the missed study matter.
Accommodation:	BUT provides good-class accommodation in modern halls of residence, mostly in double rooms. Each pair of rooms shares a bathroom and a kitchenette. Students can use the laundry rooms for minimum price. There are many facilities available for students: fitness centre, gym, boulder centre, cinema, student club, bar, snack bar, post office, grocery, drugstore etc. The price of a bed in a double room is approximately 150 USD per month.
Cost of Living:	The cost of living is low in the Czech Republic compared to most Western

	countries, and you will be able to live comfortably without spending large sums. A cost of a meal for two in a common restaurant is usually not more than 30 USD. Totally, student's expenses are approximately 500 USD per month excluding costs of accommodation and entertainment expenses.
International Students Club:	International Students Club is a friendship organization of Czech students who support all international students studying at Brno University of Technology. It befriends and helps international students during their time here in Brno through practical help, social and recreational activities, trips, Czech conversation classes. The goal of the International Club is to create a comfortable and open background for all international students at BUT. Central foreign department runs a welcome programme together with the International Students Club at the beginning of every semester. Welcome week includes 4 days of intensive course in Czech (from Monday to Thursday) at the language department of the Faculty of Civil Engineering and 3 day orientation weekend. During this time you will visit BUT centre, faculties and meet some university representatives. A tour of Brno and its surrounding, an excursion to the South of Moravia is also arranged. The whole programme is provided free for Erasmus, CEEPUS and other exchange students.
Leisure Time:	Brno's cultural life is extremely rich and varied. National Theatre companies in the Janacek and Mahen Theatres play full-scale operas, ballets and plays, while the city's two experimental theatres, the Goose on a String and HaDivadlo companies, offer exciting and controversial alternatives to more traditional productions. Those interested in a dose of Western culture can find the latest films in the original English, alongside films in Czech for the more adventurous, at the city's many cinemas and two multiplexes. Notable among Brno's numerous galleries is the Moravian Gallery, featuring works by major Czech and international artists, and the Brno City Museum (located in the historical Spilberk Castle), featuring several exhibits dedicated especially to the city's rich history. The State Philharmonic Orchestra performs regular concerts in various halls, often featuring the work of great Czech composers such as Dvorak, Smetana and Janacek, whose creative life was so closely linked with Brno. The city was also a major centre of the Functionalist movement in architecture between the wars, and today buildings such as Mies van der Rohe's landmark Tugendhat Villa (recently designated a UNESCO World Heritage site) are open to the public. Brno offers a wide range of sporting and recreational opportunities. The city of Brno also provides dozens of sporting facilities, including three indoor swimming pools, six open-air swimming pools and two winter stadiums. The enormous Boby Centrum, the largest of these facilities, boasts squash facilities, a bowling alley and some of the best workout facilities in the Czech Republic, not to mention the country's largest discotheque. The Brno Lake, easily accessible by public transport, is a popular site for swimming and outdoor recreation. Golf, hiking and skiing are also available in the area.

Appendix A: Faculty of Information Technology, Brno University of Technology - General Information

The Faculty of Information Technology (FIT) at Brno University of Technology was established on 1st January 2002. It was developed from the former Department of Computer Science and Engineering, Faculty of Electrical Engineering and Computer Science, Brno University of Technology. The Department of Computer Science and Engineering was established in 1964 and has had a long tradition in teaching computer science and informatics in the framework of the former Faculty of Electrical Engineering, later called Faculty of Electrical Engineering and Computer Science (FEECS).

At present, the Faculty of Information Technology offers a three-year Bachelor study programme Information Technology (Bc.), a two-year follow-up Master study programme Information Technology (Ing.), and Ph.D. study programme in the scientific branch Information Technology. These study programmes respect the principles of the Bologna Declaration for the development of tertiary education in Europe. The structures of both study programmes are fully compatible with the European space for higher education.

The second-level students and postgraduate doctoral students are involved in research projects, which form an important part of the Faculty activities. A considerable part of teaching and research activities is centralized in the Computer Centre. Apart from the scheduled laboratory work, students work individually on their own semester, year or diploma projects. Laboratories equipped with personal computers are at their disposal as well as the laboratory with workstations. All the computers are interconnected in the local network, which is connected to the Internet.

Appendix B: Course List Details

SVS: Embedded System Specification
Semester: Summer (Spring)

ECTS: 5/ 3 US credits
Lectures: 39 hours
Laboratory: 13 hours
Department: Information Systems
Lecturer: Miroslav Sveda, Ph.D., professor

Knowledge Prerequisits: Propositional logic. Basics of the first-order logic. The elementary notions of communication protocols.

Assessment Method: final written examination, laboratory exercises

Aim: Understand formal specification principles as applied to embedded systems design; be aware of utilizing temporal logics for modeling reactive systems and real-time systems; be aware of embedded distributed system architectures.
Syllabus:
Embedded distributed system design principles, Reactive system and real-time system models, Fairness, livness, safety, feasibility; real-time liveness, Temporal logic fundamentals, Time models and temporal logics, Temporal logic and real time, Formal specifications of embedded systems, Provers, Model checking, Real-time systems verification, Formal specification of abstract data types and objects, algebraic specifications, Using type theoretic systems for formal specification and verification of programs.
WebSite: http://www.fit.vutbr.cz/study/course-l.php.en?id=6445

POS: Advanced Operating Systems
Semester: Summer (Spring)

ECTS: 5/ 3 US credits
Lectures: 39 hours
Laboratory: 13 hours
Department: Information Systems
Lecturer: Petr Lampa, lecturer

Knowledge Prerequisits: C language programming in Unix environment, computer architecture, Intel x86 assembler, basic principles of operating systems.

Assessment Method: final written examination, laboratory exercises

Aim: The goal is to acquaint students with the principles and concepts that are used as a basis of modern operating system kernels.

Syllabus:
Kernel structure, interface, system calls, context switch, interrupts, system interface, Unix systems interface, standardization, SVID, XPG. Processes and POSIX threads, creating processess and threads, threads implementation. Paralel programming, synchronization, synchronization basics, mutual exclusion using memory read&write. Synchronization using special instructions on uniprocessor and multiprocessor systems with shared memory, priority inversion and solution. Synchronization tools and programming languages frameworks, classical synchronization tasks and their solutions. Processor scheduling, strategy, implementation, scheduling algorithms for uniprocessor systems.Resource allocation, deadlock, deadlock avoidance, solutions for CR and SR systems.
Memory architecture, paging, page tables and TLB. Virtual memory, paging algorithm, page replacement algorithms. Practical aspects of virtual memory - code sharing, memory sharing, locking, dynamic libraries, file mapping, kernel memory. Input and output, drivers, synchronous and asynchronous operations, disk I/O optimization. Files systems, organization, space allocation, free space allocation, failure recovery, Unix file systems, BSD FFS and log based file systems. Security and protection, system access, data protection, security risks.
WebSite: http://www.fit.vutbr.cz/study/course-l.php.en?id=6401

KKO: Data Coding and Compression
Semester: Summer (Spring)

ECTS: 5/ 3 US credits
Lectures: 26 hours
Laboratory: 26 hours
Department: Computer Systems
Lecturer: Vladimir Drabek, Ph.D., associate professor

Knowledge Prerequisits: Knowledge of functioning of basic computer units.

Assessment Method: final written examination, laboratory exercises

Aim: To give the students the knowledge of basic compression techniques, the methods for lossy and lossless data compression their efficiency, statistical and dictionary methods, hardware support for data compression.
Syllabus:
Introduction to compression theory. Basic compression methods. Statistical and dictionary methods. Huffman coding. Adaptive Huffman coding. Arithmetic coding. Text compression. Lossy and lossless data compression.
Dictionary methods, LZ77, 78. Variants of LZW. Transform coding, Burrows-Wheeler transform. Other methods.
Hardware support for data compression, MXT.
WebSite: http://www.fit.vutbr.cz/study/course-l.php.en?id=6349

VNV: High Performance Computations
Semester: Summer (Spring)

ECTS: 5/ 3 US credits
Lectures: 26 hours
Laboratory: 26 hours
Department: Computer Systems
Lecturer: Jiri Kunovsky, Ph.D., associate professor

Knowledge Prerequisits: Basic lectures of mathematics at technical universities.

Assessment Method: final written examination, laboratory exercises

Aim: To provide overview and basics of practical use of parallel and quasiparallel methods for numerical solutions of sophisticated problems encountered in science and engineering..
Syllabus:
Methodology of sequential and parallel computation (feedback stability of parallel computations). Extremely precise solutions of differential equations by the Taylor series method. Parallel properties of the Taylor series method. Basic programming of specialised parallel problems by methods using the calculus (close relationship of equation and block description). Parallel solutions of ordinary differential equations with constant coefficients, library subroutines for precise computations. Adjunct differential operators and parallel solutions of differential equations with variable coefficients. Methods of solution of large systems of algebraic equations by transforming them into ordinary differential equations. The Bairstow method for finding the roots of high-order algebraic equations. Fourier series and parallel FFT. Simulation of electric circuits. Solution of practical problems described by partial differential equations. Control circuits. Conception of the elementary processor of a specialised parallel computation system.
WebSite: http://www.fit.vutbr.cz/study/course-l.php.en?id=6463

DBS: Diagnosis and Safe Systems
Semester: Summer (Spring)

ECTS: 5/ 3 US credits
Lectures: 39 hours
Laboratory: 16 hours
Department: Computer Systems
Lecturer: Vladimir Drabek, Ph.D., associate professor

Knowledge Prerequisits: Principles of computer organization.

Assessment Method: final written examination, laboratory exercises

Aim: To give the students the knowledge of methods for generation the tests for logic circuits, minimization and compression algorithms, and approaches to the design of testable circuits.
Syllabus:
Test generation approaches. Funkctional tests. Sequential circuit testing. Test generation at RTL level. Random and pseudorandom test generation. Location sequences. Fault dictionaries. Diagnostic data compression. Design for testability. Built-in diagnosis. Memory testing. Processor and wiring testing. Fail-safe circuits. Fault-tolerance priciples. Diagnostic equipment.
WebSite: http://www.fit.vutbr.cz/study/course-l.php.en?id=6240

SEP: Term Project
Semester: Summer (Spring)
ECTS: 5/ 3 US credits
Lectures: N/A
Laboratory: N/A
Department: Information Systems, Computer Systems
Lecturer: according the project supervisor

Aim: The fundamental goal of this course is to support the individual creative student work during the engineering project solving, its formal description, and defense.
Syllabus:
Seminars about the solved projects. Free access to laboratory equipment. Consultations with the project supervisor.