Technical University of Liberec,
Faculty of Mechatronics, Informatics and Interdisciplinary Studies

and

Université Paul Sabatier Toulouse

Master Study Programme Guide
“Engineering of Interactive Systems”
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1 Preface

French Czech master’s double degree programme “Ingénierie des systèmes intéractifs“-“Engineering of Interactive Systems“ is a result of cooperation between the Technical University of Liberec, Faculty of Mechatronics, Informatics and Interdisciplinary Studies (TU Liberec) and the Paul Sabatier University in Toulouse. Students have to attend the courses in two locations: the Technical University of Liberec and the Paul Sabatier University in Toulouse. During the first year, all of the students have to follow the first semester in Toulouse and the second semester in Liberec. In the second year, they can choose any of these two locations and attend the second year courses either in Toulouse or in Liberec. The student’s decision to study in Liberec or in Toulouse applies to the whole second year of the study programme, i.e. it is not possible to study the third semester in Toulouse and the fourth semester in Liberec or vice versa.

All of the courses offered by the Technical University of Liberec and also all of the first-year courses in Toulouse are taught in English. Thus, no knowledge of the French language is necessary for the students that will spend the second year of their studies in Liberec. However, good working knowledge of French is necessary for the students that will spend the second year of their studies in Toulouse because some of the second-year courses will be taught in French. Students entering the programme without the knowledge of French will be given enough opportunity to learn French during the first year of the study if they wish so.

The final diplomas will be issued by the Technical University of Liberec (degree “inženýr”- Ing. including the “Diploma supplement”) in the accredited study programme “Electrical Engineering and Informatics”, study field “Engineering of Interactive Systems” and by the Paul Sabatier University in Toulouse, Institut Universitaire Professionnalisé - Systèmes Interactifs (degree of “Master en Ingénierie des Systèmes Interactifs”).

The whole study programme has a strongly multidisciplinary character. The main objective of the study is to obtain sound theoretical knowledge and practical skills in the field of the interactive intelligent systems. To achieve this objective the students must become familiar with a wide variety of disciplines such as Computer Science and Informatics, Artificial Intelligence, Mechatronics, Automatic Control and Robotics. This carefully selected blend of important subjects makes the graduates well prepared to meet the future demands of the European labour market. The graduates will find positions in innovative technological companies and the best of them will have an opportunity to study for the PhD degree either at Technical University of Liberec or at Paul Sabatier University in Toulouse.

Besides becoming highly qualified experts, the students taking part in this international study programme will also benefit from a rich inter-cultural experience and become familiar with specific feature and lifestyles of two culturally much different regions of Europe.

2 Structure and Courses of the Master programme Engineering of Interactive Systems

The structure of this study programme, which was briefly outlined in the introduction, is illustrated in Fig.1. All of the students spend the first semester in Toulouse and the second semester in Liberec, while the whole second year of the study programme (third and fourth semester) takes place either only in Liberec or only in Toulouse according to the decision of each student.

In each semester, the minimum of 30 ECTS credits must be earned. Only students that have obtained at least 120 credits are allowed to take the final state examination.
Fig. 1 Pattern of the semesters for the Engineering of Interactive Systems.

### 2.1 First year of the study programme – winter semester

#### 2.1.1 Courses, Study load, Credits

The first semester is always taught at the Paul Sabatier University in Toulouse. The list of the courses is given in Table 1.

<table>
<thead>
<tr>
<th>Course name</th>
<th>ECTS Credits</th>
<th>Assessment</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compulsory courses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parallel Programming</td>
<td>3</td>
<td>Exam.</td>
<td>Marie-Pierre Gleizes, UPS</td>
</tr>
<tr>
<td>Control of Systems</td>
<td>9</td>
<td>Exam</td>
<td>Viviane Cadenat, Marie-Christine Lagasquié, Michel Taix, UPS</td>
</tr>
<tr>
<td>Advanced Programming</td>
<td>6</td>
<td>Exam</td>
<td>Veronique Gaildrat, Marie-Christine Lagasquié, UPS</td>
</tr>
<tr>
<td>Analysis and Synthesis</td>
<td>6</td>
<td>Exam</td>
<td>Philippe Joly, UPS</td>
</tr>
<tr>
<td>Opening/H-M Communication</td>
<td>3</td>
<td>Exam</td>
<td>Michel Taix, UPS</td>
</tr>
<tr>
<td>Language English/French</td>
<td>3</td>
<td>Exam</td>
<td></td>
</tr>
<tr>
<td>Minimum number of credits</td>
<td><strong>30</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.1.2 Short descriptions of the courses

**Parallel Programming**

This course presents the models and software concepts to design parallel programs. It is mainly focused on the following topics:

- The notion of processes and threads
- The main issues and potential pitfalls of the parallel programming, in particular the mutual exclusion problem.
- Some well-known mechanisms are studied and the different concepts will be illustrated and experimented with UNIX.
Control of Systems
This course is focused on two closely connected fields: robot control and artificial intelligence. The robotics part deals with the issues arising in applications of robotics into areas such as agriculture, nuclear, spatial, underwater, etc, where the environments are dynamic and large autonomy abilities for the robot are required. To this aim, the robot must be equipped with dedicated sensors to perceive its environment, to interpret it, and finally to act on it to perform the desired task. The objective of the artificial intelligence part of this course is to teach the students how to represent a problem in AI and to apply some resolution techniques. The main topics covered in this course are as follows:

- A brief survey about robotics history and introduction to the key-notions of robotics
- Modelling and control problems of mobile robots and manipulator arms.
- Overview of the sensors and actuators that are usually used in the robots.
- Modelling of a problem by state spaces.
- Presentation of the main research algorithms (blind or informed search methods).
- Decomposition of a problem in sub-problems.
- Constraint satisfaction problems.

Advanced Programming
This course introduces the students into the methodology and principles of programming with particular emphasis on the advanced concepts of object-oriented design and object-oriented programming. A methodology based on UML (Unified Modelling Language) is used to define and express concepts related to oriented object design, and Java Language is used for the implementation of object-oriented concepts. The main topics addressed are as follows:

- Presentation of a programming methodology
- Formal specifications in logic language as a starting point
- The use of the techniques issued from programming proofs (invariants, pre and post-conditions, etc.) to write a "good" algorithm corresponding to the given problem that was formally specified.
- General concepts of object-oriented programming
- Advanced concepts, Objects, Classes
- Conception and object-oriented programming
- Design methodology with UML
- Functional, dynamic and static points of view

Analysis and Synthesis
Selected technologies in the digital image and the natural language processing domains are presented. In particular, the following topics are addressed:

- Colour quantization, linear and non-linear filters, morphomathematics, and image segmentation
- Shading and lighting modelling, surface, texture, object and scene modelling
- Natural language understanding

Opening/Human -Machine Communication
This course presents some technologies which are necessary to build interactive systems. The main focus is on the following topics:

- Introduction to distributed computing
- Motion Planning from robot to virtual human
- Presentation of a model for handling uncertain knowledge in decision support systems
- Local Networks for industrial systems and embedded systems.
- Example of an industrial problem
2.2 First year of the study programme – summer semester

2.2.1 Courses, Study load, Credits

All courses in this semester are taught in Liberec. The list of the courses is given in the Table 2.

<table>
<thead>
<tr>
<th>Course name</th>
<th>Weekly load</th>
<th>ECTS Credits</th>
<th>Assessment</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Compulsory courses</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automatic Control</td>
<td>2+2</td>
<td>5</td>
<td>Exam</td>
<td>Modrlák O., MTI</td>
</tr>
<tr>
<td>Systems Identification</td>
<td>2+2</td>
<td>5</td>
<td>Exam</td>
<td>Janeček B., MTI</td>
</tr>
<tr>
<td>Digital Control</td>
<td>2+2</td>
<td>5</td>
<td>Exam</td>
<td>Hlava J., MTI</td>
</tr>
<tr>
<td>Image Analysis</td>
<td>2+2</td>
<td>5</td>
<td>Exam</td>
<td>Chaloupka J., ITE</td>
</tr>
<tr>
<td>Semester Project</td>
<td>0+4</td>
<td>5</td>
<td>Graded credit</td>
<td></td>
</tr>
<tr>
<td><strong>Compulsory elective courses</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smart Sensors and Actuators</td>
<td>2+2</td>
<td>5</td>
<td>Exam.</td>
<td>Nosek J., Mokrý P. MTI</td>
</tr>
<tr>
<td>Digital Signal Processing</td>
<td>2+2</td>
<td>5</td>
<td>Exam</td>
<td>Koldovský Z., ITE</td>
</tr>
<tr>
<td>Design of the Electrotechnical</td>
<td>2+2</td>
<td>5</td>
<td>Exam</td>
<td>Novák M. MTI</td>
</tr>
<tr>
<td>Systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hardware Software Codesign</td>
<td>2+2</td>
<td>5</td>
<td>Exam</td>
<td>Novák O., Plíva Z. ITE</td>
</tr>
<tr>
<td>Electronic Circuits and Components</td>
<td>2+2</td>
<td>5</td>
<td>Exam</td>
<td>Doležal I., Kolář M., MTI</td>
</tr>
<tr>
<td><strong>Minimum number of credits</strong></td>
<td></td>
<td></td>
<td></td>
<td>30</td>
</tr>
</tbody>
</table>

2.2.2 Short descriptions of the courses

**Automatic Control**

This course offers a comprehensive overview of automatic control with an emphasis on an appropriate balance between the theoretical concepts and engineering practice in analysis, synthesis of linear control systems. The main topics covered are as follows:

- Mathematical models and analysis of linear dynamic systems
- Feedback control, PID controllers, empirical methods of tuning of PID controllers
- The root-locus method, frequency response techniques
- Cascade control, feedforward control, internal model control
- Introduction to uncertainty description and robust control

**System Identification**

The course covers identification methods of linear and nonlinear dynamic SISO and MIMO systems under presence of noise and disturbances. The main topics covered are as follows:

- Characteristics of stochastic signals: correlation function, covariance, frequency spectrum, power spectral density. Stochastic signal - filtration.
- Identification of continuous linear and nonlinear systems with use of optimization methods.
- Discrete models and their identification.
- Methods of frequency spectrum and power spectral density computation.
- Identification of MIMO linear dynamic system.
- Application examples and case studies
Digital Control
This course is designed to provide the students with a good understanding of the digital control systems design and implementation. The main focus of this course is on model predictive control (MPC). The main topics covered are as follows:
- Sampling, stability of discrete systems, discretization of continuous systems
- Implementation of digital controllers, implementation structure, effects of finite word length
- Pole placement design of digital controllers, Design of controllers with finite control time, algebraic methods
- Model predictive control (MPC), receding horizon principle
- Dynamic Matrix Control, Generalized predictive control (GPC), constraints in MPC algorithms, feasibility of constraints

Image Analysis
This course gives an overview of the image analysis and it is focused mainly on the following topics:
- Image pre-processing, pixel brightness transformation, gray-scale transformation, geometric transformation, image smoothing, edge detectors, image restoration
- Segmentation, 2D linear discrete image transforms
- Mathematical morphology: binary and gray-scale opening and closing
- Skeletons and object marking, granulometry, morphological segmentation and watersheds

Semester project
The purpose of the semester project is to prepare the students to solve more complex technical tasks than those that are dealt with in the individual courses. Typically the project assignment requires the students to solve a given technical problem or to design a device to serve a particular purpose. Usually some design parameters are given; the selection of methods needed to develop and implement the design is left to the students. The proposed topics of the semester projects are announced by the institutes of the Faculty of Mechatronics. Students have to select one of them. Project will be assigned by the project supervisor in written form including the specifications of the project objectives and expected results. Project has to be closed by project defence. The date of project defences is given by notice of the dean.

Digital Signal Processing
This subject provides a study of modern digital signal processing and some of its major engineering applications. The main topics covered are as follows:
- Spectral analysis, digital filtering and noise reduction
- Speech and image processing
- Digital implementation and practical use of convolution, correlation and filtering using the Fast Fourier transform
- Basics of speech and image coding, enhancement, analysis and synthesis.

Smart Sensors and Actuators
In this course, there will be given the both theoretical overview and practical experience in the area of selected electric transducers of physical quantities. An accent will be put on the application of smart materials in such systems. Students will acquire the basic concepts of the application of piezoelectric, ferroelectric and piezoresistive materials in electrical transducers, including the practical experience from demonstrations of real experimental systems. The main topics covered are as follows:
- Sensors and actuators of the advanced mechatronic system, Smart materials and their use for actuators and sensors.
• Piezoelectric materials and their properties. Piezoelectric sensors and their use measuring selected physical quantities (force, pressure, acceleration, vibrations, and shocks).
• Piezoelectric resonators, Electric equivalent circuit of the resonator. Measurement of the resonance frequency. Resonator as a sensor of the physical chemical and biological quantities.
• Piezorezistive effect in the non-piezoelectric crystal, piezorezistive sensors.
• Intelligent semiconductor sensors and microelectromechanical systems (MEMS)
• Piezoelectric thin films deposited on the Si-substrate. Measurements of the small mechanical displacements by laser interferometry.

**Design of Electrotechnical Systems**
This course teaches students necessary theory of electrical engineering needed for design of distribution boards and electrical equipment of machines and buildings. The aim is industrial applications from low voltage switchboards to manipulators and machinery ending with production lines of mass production. The main topics covered are as follows:

- CAD/CAE/CAM systems at electrical engineering
- Theory of protection devices, design, selectivity of protection, Over voltage protections
- Switchboard parts, control parts, measuring devices, user friendliness
- Switching devices
- Power supplies, properties of low voltage power net
- Switch board cooling, thermal behaviour
- Building installations
- Students learn basics of electro technical documentation at practical lessons. The teaching is based on CAD/CAE system ePLAN.

**Hardware Software Codesign**
Course objective is to present techniques for concurrent hardware and software development so called hardware/software co-design. Students will be familiarized with

- models for hardware and software behavioural description
- H/S cooperation, algorithms partitioning tasks into hardware and software.
- Simulation, synthesis and verification techniques
- In labs, students will use FPGA circuits and Xilinx or Mentor design tools.

**Electronic Circuits and Components**
This course is focused on advanced topics in electronics. The main topics covered are as follows:

- Selected, more complex analogue and mixed circuits for instrumentation, control, electroacoustics, communication and radioelectronics.
- Basics of modulation/demodulation, principles of radio receivers and radio systems/services
- Progressive design methodology of electronic equipments, the VHDL language
- Architecture of custom integrated circuits and their application in electronic systems
- Laboratory experiments focused on selected mixed circuits connected from real devices, circuit simulation using PSPICE and FPGA configuration design and its evaluation on an evaluation board.

### 2.3 Second year of the study programme
The second year courses can be taken either in Liberec or in Toulouse. The second year curricula at both universities are different in many respects and the students must decide whether they will spend the whole second year in Liberec or in Toulouse. Good working knowledge of French is essential for the students deciding to follow the second year courses in Toulouse. All of he second year courses at Technical University of Liberec are taught in English.
2.3.1 Third semester - Liberec

2.3.1.1 Study load, Credits

The list of the third semester courses taught in Liberec is given in the Table 3.

<table>
<thead>
<tr>
<th>Course name</th>
<th>Weekly load</th>
<th>ECTS Credits</th>
<th>Assessment</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Control Systems</td>
<td>2+2</td>
<td>5</td>
<td>Exam</td>
<td>Tůma P., MTI</td>
</tr>
<tr>
<td>Nonlinear Systems</td>
<td>2+2</td>
<td>5</td>
<td>Exam</td>
<td>Mrázek P., Hlava J.MTI</td>
</tr>
<tr>
<td>Adaptive Control</td>
<td>2+2</td>
<td>5</td>
<td>Exam</td>
<td>Janeček B., MTI</td>
</tr>
<tr>
<td>Diploma Thesis</td>
<td>0+5</td>
<td>5</td>
<td>Credit</td>
<td></td>
</tr>
</tbody>
</table>

**Compulsory elective courses**

<table>
<thead>
<tr>
<th>Course name</th>
<th>Weekly load</th>
<th>ECTS Credits</th>
<th>Assessment</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design of Automated Systems</td>
<td>2+2</td>
<td>5</td>
<td>Exam</td>
<td>Modrláč O., Školník P., RSS</td>
</tr>
<tr>
<td>Control of Electrical Drives</td>
<td>2+2</td>
<td>5</td>
<td>Exam</td>
<td>Černohorský J., MTI</td>
</tr>
<tr>
<td>Simulation of Electromechanical Systems</td>
<td>2+2</td>
<td>5</td>
<td>Exam</td>
<td>Potěšil A., Novák J. NTI</td>
</tr>
<tr>
<td>Speech Processing in Human-Computer Interaction</td>
<td>2+2</td>
<td>5</td>
<td>Exam</td>
<td>Nouza J., ITE</td>
</tr>
<tr>
<td>Minimum number of credits</td>
<td></td>
<td>30</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.3.1.2 Short descriptions of the courses

**Computer Control Systems**

The course is an introduction to the field of hardware and software of computer control systems. The main topics covered are as follows:

- Architecture of advanced microcontrollers for embedded systems
- Standard industrial serial communication interfaces and protocols for industrial communication
- Signal conditioning, Measuring of analogue signals, digitalisation of continuous signals, digital to analogue conversion
- Interrupt systems, timers, microcontrollers in real-time systems
- Float point computing using mathematical libraries
- Implementation of standard control algorithms (PID). Multilayer control structures, hierarchical structure of control systems,
- Reliability and diagnostic of control systems

**Nonlinear Systems**

This course is an introduction to the field of non-linear systems and non-linear control. A particular emphasis is put on definitions of stability and methods of stability analysis. The most important approaches to non-linear control synthesis are explained. The main topics covered are as follows:

- Non-linear dynamical systems, Phase space analysis, analytical and numerical methods.
- Stability of non-linear systems, Lyapunov methods, Popov criterion
- Relay and time optimal controls, Describing functions method.
- Synthesis of non-linear control systems, feedback linearization.
• Sliding mode control
• Hybrid dynamical systems, PWA and MLD systems

Adaptive Control
The objective of the course is to introduce the students into advanced methods of adaptive control of dynamic systems. The main topics covered are as follows:
• Estimator of the state variables of the system, computation methods.
• Least square identification method for SISO systems identification.
• Recursive least square identification method with exponential forgetting for SISO and MIMO systems
• Self tuning adaptive controllers with real-time parameters identification.
• Stochastic signal exciting the linear system, auxiliary deterministic disturbances entering the output of adaptive controller and their influence on improving of adaptation process. Adaptation process during the reference variable changes.
• Gain scheduling controllers.

Design of Automated Systems
The aim of this course is application of the knowledge that students acquired during their previous studies. The course covers dealing with resources and methods of designing in engineering experience, implementation of automation into technological and industrial processes. Application of general principle and ideas is demonstrated on the professional CAD/CAE software Aucotec ELCAD/AUCOPLAN 7. The main topics covered are as follows:
• Design and operation of automated systems, control hierarchy. Informatics and automated control - theory, social and economics conditions.
• General purpose of engineering and design work. Quality as the hierarchically highest aim. Reliability. Economic effectiveness. Social and economic aspects and the human factor.
• Classification and designation of documents for plants, systems and equipment in accordance with CSN EN 61355.
• CAD/CAE systems. Basic concept of the database system ELCAD/AUCOPLAN.

Control of Electrical Drives
This course teaches students basic principles of electrical drives, basic knowledge of servomechanisms such as servodrives, drive and motion controllers and industrial communication networks. Drive mathematical modelling and control structures are also treated in this course. The main topics covered are as follows:
• Drive principles and construction (DC, ECDC, Stepper, Synchronous, Induction, linear and torque drives), Characteristics of drives and usage of drive in industry
• Control structure of servodrives (Torque, Speed, Position mode, Master Slave, Electronic gearbox, Electronic cams)
• Pulse Width Modulation, Sensorless Speed Control, Direct Torque Control
• Speed and position sensors
• Industrial bus systems
• Drive tuning and programming of motion controllers.

Simulation of Electromechanical Systems
The purpose of this course is the introduction to the numerical modelling of electro-mechanical systems. Theoretical and practical results are given that refer to the steps of building the numerical model and its setting up for the particular application. The main topics covered are as follows:
Identification of the engineering problem and adequacy of the analysis using the finite element method (FEM). Concepts and elementary equations of the mechanics of continuum applied in FEM.

Types of FEM tasks according to the boundary conditions, material models and process and operational modes.

Computer processing in FEM. Review of the FEM SW products.

Example solutions of the selected types of tasks and solutions of the problems of mechanics of the continuum. Methods of the modal, harmonic and transient analyses.

Simulations of multi-body systems, multi-physical so called mixed problems of continuum.

**Speech Processing in Human-Computer Interaction**

The purpose of this course is to give an in depth overview of speech processing techniques and to explain the use of these techniques in human computer interaction. The main topics covered are as follows.

- Introduction to speech processing, demonstration of speech processing systems.
- Speech, speech signal, basic elements of spoken and written language, introduction to phonetics.
- Automatic speech recognition, isolated-word recognition - how it works.
- Speech signal parameterization, speech endpoint detection.
- Linear and non-linear time warping in speech recognition, hidden Markov models.
- Continuous speech recognition, acoustic and language model.
- Speech synthesis. TTS systems.

**2.3.2 Fourth semester - Liberec**

**2.3.2.1 Study load, Credits**

The list of the fourth semester courses taught in Liberec is given in the Table 4.

<table>
<thead>
<tr>
<th>Course name</th>
<th>Weekly load</th>
<th>ECTS Credits</th>
<th>Assessment</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diploma Seminar</td>
<td>0+3</td>
<td>3</td>
<td>Graded credit</td>
<td>Tůma P./Hlava J., MTI</td>
</tr>
<tr>
<td>Diploma Thesis</td>
<td>0+12</td>
<td>12</td>
<td>Credit</td>
<td></td>
</tr>
</tbody>
</table>

**Compulsory elective courses**

<table>
<thead>
<tr>
<th>Course name</th>
<th>Weekly load</th>
<th>ECTS Credits</th>
<th>Assessment</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Methods of Control</td>
<td>2+2</td>
<td>5</td>
<td>Exam</td>
<td>Hlava J., MTI</td>
</tr>
<tr>
<td>Intelligent Robots</td>
<td>2+2</td>
<td>5</td>
<td>Exam.</td>
<td>Záda V., MTI</td>
</tr>
<tr>
<td>Real Time Control Systems</td>
<td>2+2</td>
<td>5</td>
<td>Exam.</td>
<td>Hlava J., MTI</td>
</tr>
<tr>
<td>Fuzzy Control</td>
<td>2+2</td>
<td>5</td>
<td>Exam</td>
<td>Modrlák O., RSS</td>
</tr>
</tbody>
</table>

| Minimum number of credits                 |             | 30           |            |             |

**2.3.2.2 Short descriptions of the courses**

**Diploma thesis**

The topic of the diploma thesis is assigned in the beginning of the winter semester and the diploma thesis should be finished before a date that is specified by the dean of the faculty for each academic year. Typically this date is several days before the end of the summer semester. The topics for
diploma theses are proposed by the faculty members as well as by industrial companies. In the diploma thesis the students should demonstrate their ability to solve complex technical and/or research problems.

**Diploma Seminar**
- Communication skills at diploma thesis work
- Preparation: six key points
- Objectives, Audience, Content, Organization, Visual information, Practice
- Giving talks and presentations
- Presentation, Signposting language, Delivery

**Applied Methods of Control**
This course is focused on practical applications of automatic control methods. Particular emphasis is put on those features present in controlled plants and systems that complicate or even exclude the application of classical linear finite dimensional control theory. Such features include
- time delay systems including systems with internal delays
- non-linear behaviour and interaction of continuous and logical controls
- hybrid control

**Intelligent Robots**
The course *Intelligent Robots* is focused to the using of some methods of artificial intelligence in the area of robotics, firstly in the trajectory planning and task planning.
- Task-level programming
- Gross-motion and Fine motion planning
- Predicate logic
- Task solving in robotics and heuristics
- Task-planning, source and global scene, scene analysis, task planner simulation.

**Real Time Control Systems**
This course is designed to provide the students with a good understanding of the basics of real time systems design. The main topics covered are as follows:
- Real-Time Systems, definitions, hard versus soft real time systems, real time control systems,
- Commonly used approaches to real-time scheduling, scheduling of periodic tasks, priority driven scheduling, resource access control.
- Inter-process communication synchronisation, deadlock, semaphores, queues
- Introduction into digital control, computer implementation of control algorithms

**Fuzzy Control**
This course offers an introduction to fuzzy control and intelligent control methods. The course objectives are the basic of fuzzy logic and its implementation for decision and control, design of fuzzy controllers and control with neural networks. The main topics covered are as follows
- Linguistic variables, values and rules
- Membership function, fuzzy sets, fuzzy logic and the rule – base, Fuzzyfication, Inference mechanism, defuzzyfication
- Basics of fuzzy control, fuzzy PD, PI und PID- controller design
- Fuzzy controller implementation
- Introduction to neural networks, Neural-network-based control
2.3.3 Third semester - Toulouse

2.3.3.1 Study load, Credits

The list of the third semester courses taught in Toulouse is given in the Table 5.

<table>
<thead>
<tr>
<th>Table 5</th>
<th>Semester: 3. (winter), 12 weeks, Toulouse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course name</td>
<td>Lectures</td>
</tr>
<tr>
<td>Real Time Control Systems</td>
<td>58</td>
</tr>
<tr>
<td>Cooperative and Interactive Systems</td>
<td>48</td>
</tr>
<tr>
<td>Industrial Project Management</td>
<td>30</td>
</tr>
<tr>
<td>Computer Technologies for Interaction</td>
<td>46</td>
</tr>
<tr>
<td>Professional Insertion</td>
<td>44</td>
</tr>
<tr>
<td>Minimum number of credits</td>
<td></td>
</tr>
</tbody>
</table>

2.3.3.2 Short descriptions of the courses

Real Time Control Systems

- Real time critical systems engineering
- Petri nets
- VHDL
- Operating Systems and real time control
- Conferences on real time industrial systems
- Real time systems integration

Cooperative and Interactive Systems

- Interactive systems engineering
- Augmented and distributed virtual reality
- Advanced methods in image synthesis
- Human-Machine oral dialog
- Visual Interaction

Industrial Project Management

- Project management
- Project analysis methods
- Project planning

Computer Technologies for Interaction

- Distributed computing
- Decisional graphs
- Motion planning: from robot to virtual avatar
- Industrial conferences
- Industrial local networks
Professional Insertion
- Employment interview in English
- Product legal aspects

2.3.4 Fourth semester - Toulouse

2.3.4.1 Study load, Credits
The list of the fourth semester courses taught in Toulouse is given in the Table 6. The main focus of this semester is on large independent project and most importantly on vocational training in an industrial company.

<table>
<thead>
<tr>
<th>Course name</th>
<th>Study load</th>
<th>ECTS Credits</th>
<th>Assessment</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vocational Training</td>
<td>5 months.</td>
<td>21 Credit</td>
<td>Credit</td>
<td>Philippe Truillet</td>
</tr>
<tr>
<td>Project</td>
<td>0+12</td>
<td>9 Credit</td>
<td></td>
<td>Agnan de Bonneval</td>
</tr>
</tbody>
</table>

2.3.4.2 Short descriptions of the courses

Project
It consists in large scale project integration, gathering all the class, jointly with an industrial partner.

Vocational Training
Student works as an intern engineer for a company during at least 5 months (March to August).

3 Policy and Legal Procedures

3.1 Common boards
1. The study is governed by a common board that abides by the valid study and examination regulations of both universities. The members of this board are persons responsible for this double degree study programme and selected lecturers responsible for the courses.
2. Further common boards are established for the final state examinations, semester and diploma projects according to the needs and study regulations of both universities.

3.2 Students
1. The study programme “Engineering of Interactive Systems” is open to all students holding bachelor degree from the study programme Electrical Engineering and Informatics or from similar study programs valued at a minimum of 180 credits in the European Credit Transfer System. (ECTS).
2. The number of admitted students is supposed to be about 16 Master’s students in each academic year.
3.3 Study structure

3.3.1 Place of study
In the first year, all of the students have to follow the first semester in Toulouse and the second semester in Liberec. In the second year, they can choose any of these two locations and attend the second year courses either in Toulouse or in Liberec. The student’s decision to study in Liberec or in Toulouse applies to the whole second year of the study programme. It is not possible to study the third semester in Toulouse and the fourth semester in Liberec or vice versa.

3.3.2 Language of instruction
All of the courses offered by the Technical University of Liberec and also all of the first-year courses in Toulouse are taught in English. No knowledge of the French language is necessary for the students that will spend the second year of their studies in Liberec. However, good working knowledge of French is indispensable for the students that will spend the second year of their studies in Toulouse because some of the second-year courses are taught in French. Students entering the programme without the knowledge of French will be given enough opportunity to learn French during the first year of the study if they wish so. Besides the vast opportunities offered in Toulouse in the first semester there is also an intensive French course taught in Liberec in the second semester.

3.4 Study and Examination guidelines

3.4.1 Study guidelines
1. The study and examination guidelines will comply with the regulation of the university at which the students study at individual semesters. The main legal document at the Technical University of Liberec is the Study and Examination Regulations from the 23 September 2009. The main legal document at the Paul Sabatier University of Toulouse is Règles générales d’admission, de progression et de validation pour le cursus Master à l’Université Paul Sabatier.
2. Courses, including course material, instruction, examination, and study counselling are in English at both universities in the first year of the study. Second year courses are in English at Technical University of Liberec, some second-year courses may be in French at Paul Sabatier University of Toulouse.
3. Lecturers and educational personal, timetable, the form of examination in given semester will be specified by the university at which the teaching of this semester takes place.
4. Diploma Thesis should be written and defended in English. Exceptionally, the thesis can be written in French. If it is in French, it must include an extended abstract written in English.

3.4.2 Examination guidelines
1. Courses and examinations will be credited by “European Credit Transfer System ECTS”.
2. The master study programme “Engineering of Interactive Systems” is valued during two years at a minimum of 120 ECTS.
3. Students, who complete successfully the Engineering of Interactive Systems, will receive Double Master’s Degree.
3.5 Admission and Application procedure

3.5.1 Admission requirements
1. International Applicants must have a Bachelors degree in a relevant field (Electrical Engineering, Control Engineering, Informatics or similar) valued at a minimum of 180 credits in the European Credit Transfer System. (ECTS). The “Licence Professionnelle” (Professional Bachelor’s Degree) and its equivalent such as a BEng (Hons) Degree, or other bachelor-level studies should be in compliance with the Bologna Process.
2. Students enrolled by their home university have to register by the host university according the pattern of semesters.

3.5.2 Application procedure
1. The Home and European students follow the local routines for enrolment at TU Liberec and Paul Sabatier University of Toulouse.

3.5.3 Required documents
Prospective international students applying for admission at the Technical University of Liberec are required to fill in and submit the Application form. This application form is available at the web pages of the Technical University of Liberec and it should be filled in and submitted both electronically and in hard copy printed out from the electronic version, signed and sent to the address given below. Should there be problems with working with the web based application form, the applicants can ask by e-mail for sending the application form in MS Word format. Again, this application form is to be filled in, printed out, signed and sent back to the university in hard copy. The hard copy application form must be accompanied by additional documents. These documents and further admission requirements are specified as follows:
1. The applicants must provide official academic records (e.g. diplomas and transcripts) from each undergraduate or post graduate institution they have attended. Depending on the country of location of the institution that issued the undergraduate diplomas, validation of these diplomas may be required. The applicants are advised to contact the Technical University of Liberec in advance before submitting their application to obtain information which kind of validation procedure is applicable to their particular case.
2. International applicants from the non-EU countries must provide one letter of recommendation. Academic letter of recommendation from the institution where the applicant obtained his or her undergraduate diploma is preferred. It should be written by a professor who knows the applicant well (e.g. Bachelor Thesis supervisor).
3. Other supporting documents such as research reports and awards may be submitted as well.
4. International applicants whose mother tongue is not English must provide an evidence of English proficiency. Minimum TOEFL iBT total score of 80 is required.
5. International applicants must prove that they are able to pay for living expenses during their study in Czech Republic and/or France. A rough estimate of the expenses for one academic year (10 months, travel expenses and health insurance not included) in the Czech Republic is about 60 000 CZK (2 400 EUR) while in France the expenses amount to about 6000 EUR.
6. The applicants must pay a non refundable application fee to the bank account of the Technical University of Liberec. At the time of writing this booklet, the application fee is 400 CZK (ca 16 EUR) but it can change in the future.
7. Last but not least, the applicants must pass successfully an admission exam. If their results from the bachelors study are excellent, this requirement can be waived by the Dean of the Faculty of Mechatronics.
Important note: Health care expenses both in the Czech Republic and in France can be very high for uninsured students and the participating universities shall not accept any responsibility for them. Good health insurance is therefore essential and strictly required for both Czech and French part of this study programme. Besides, all travel expenses, visa administration etc. are also the applicant’s responsibility.

Application deadline: Standard deadline for submitting the applications for the following academic year is 30 April. Exceptionally, second round of admissions may be open with the application deadline being 14 August.

The final decision about the acceptance or rejection of their admission applications is sent to the applicants by the Dean of the Faculty of Mechatronics, Informatics and Interdisciplinary Studies.

Hard copy application form is to be sent to the following address:

Technical University of Liberec
Office of the Dean of the Faculty of Mechatronics
Studentská street 2
CZ – 461 17 Liberec 1
Czech Republic, Europe

E-mail enquiries should be directed to jaroslav.hlava@tul.cz

3.6 Administration, Examination results, Diploma

3.6.1 Student administration by Home University

1. Administration of information about student’s semester thesis and examination results at both universities as the study and student documentation will run at the home university using ECTS.

2. The home university runs the documentation of registered student of Hosting University too.

3.6.2 Student Administration by the Hosting University

1. The Hosting University is the primary point of contact for all students affair.

2. The Hosting University runs the documentation of registered student of Home University.

3. Regulations for the exchange of information about the students especially their examination results have been established within the applicable local law.

4. The Hosting University is responsible for delivering of examination results and other information to the Home University.

3.6.3 Diploma

Students who complete this programme successfully will receive the final diploma issued by the Technical University of Liberec (degree “inženýr”- Ing. including the “Diploma supplement”) in the accredited study programme “Electrical Engineering and Informatics”, study field “Engineering of Interactive Systems” and by the Paul Sabatier University in Toulouse, Institut Universitaire Professionnalisé - Systèmes Interactifs (degree of “Master en Ingénierie des Systèmes Interactifs”). Sample diplomas are shown in the attachment.
3.7 Fees
1. The universities TU Liberec and Paul Sabatier University of Toulouse will charge tuition fees according to their national legislation. In this time there are no tuition fees.
2. The students may have to pay enrolment fee and other administrative fees as required by local law at the Hosting University. These fees vary and generally they are unlikely to be higher than several hundreds of EUR for each academic year.
3. All fees will be collected and owned by the Hosting University and managed according the local rules and regulations.

3.8 Funding
1. The students will be supported by Erasmus LLP Programme according its structure and rules. The students should note that this programme can be expected to cover a part of their study expenses not all study expenses. Erasmus LLP Programme is intended mainly for EU students and it is open also to a relatively small number of non-EU countries. Students from non-EU countries should check whether they can be supported by Erasmus LLP Programme.
2. Both partner universities will assist in finding other sources of funding.

3.9 Finding accommodation
1. Both Technical University of Liberec and Paul Sabatier University in Toulouse operate their own halls of residence.
2. The cost of accommodation in the student halls of residence varies. In the Czech Republic, an average cost is about 100 EUR per month, in France it can be at least 150 EUR or higher.
3. The students can also find private accommodation. However, they should note that this is their own responsibility and the universities do not provide any assistance with finding private accommodation.

3.10 Execution of the study programs
1. The students, registered in this study programme at the Hosting University, have the same rights and duties as the other matriculated university students in other programs.
2. All students of the Partner University have to obey the rules and regulations of the Hosting University.
3. It is the responsibility of the Hosting University that the modules are provided by sufficiently qualified persons in accordance with the local laws and regulations.
4. The Hosting University is responsible for ensuring local laws about safety rooms, laboratory equipment etc.
4 Attachments

4.1 Sample diploma and diploma supplement issued by the Technical University Liberec
D I P L O M

ČESKÁ REPUBLIKA
Technická univerzita v Liberci

V Liberci dne 18. října 2007

Ing. [signature]

[Seals and signatures]
ČESKÁ REPUBLIKA

Technická univerzita v Liberci

DIPLOMA SUPPLEMENT / DODATEK K DIPLOMU

Diploma No / Diplom č.: 

This Diploma Supplement model was developed by the European Commission, Council of Europe and UNESCO / CEPES. The purpose of the supplement is to provide sufficient independent data to improve the international "transparency" and fair academic and professional recognition of qualifications (diplomas, degrees, certificates etc.). It is designed to provide a description of the nature, level, context, content and status of the studies that were pursued and successfully completed by the individual named on the original qualification to which this supplement is appended. It should be free from any value judgements, equivalence statements or suggestions about recognition. Information in all eight sections should be provided. Where information is not provided, an explanation should give the reason why.

Tento dodatek k diplomu odpovídá modelu vytvořenému Evropskou komisí, Evropskou radou a organizací UNESCO / CEPES. Úče-


1. Information identifying the holder of qualification / Informace o totožnosti držitele kvalifikace
1.1 Family name(s) / Příjmení:
1.2 Given name(s) / Jméno (jména):
1.3 Student identification number / Identifikační číslo studenta:
1.4 Date of birth / (day/month/year) / Datum narození:
1.5 Place of birth / Místo narození:

State of birth / Stát narození: Czech Republic

2. Information identifying the qualification / Informace o druhu kvalifikace
2.1 Name of the qualification / Název kvalifikace: Inženýr

Title conferred / Udělený titul: Ing.

2.2 Main field of study within the qualification / Hlavní studijní obor v rámci kvalifikace:

Electrical Engineering and Informatics / Elektrotechnika a informatika,

Information Technology / Informační technologie

2.3 Name and type of awarding institution / Název a postavení udělující instituce:

Technická univerzita v Liberci, Public Higher Education Institution / Vysoká vysoká škola

2.4 Name and status of institution administering studies / Název a postavení instituce zajišťující studium:

Technická univerzita v Liberci, Public Higher Education Institution / Vysoká vysoká škola

2.5 Language(s) of instruction / examination / Jazyk(y) studia / zkoušek: Czech / Čeština

3. Information on the level of the qualification / Informace o úrovni kvalifikace
3.1 Level of qualification / Úroveň kvalifikace:

Higher education / Vysokoškolské vzdělání, Master studies / Magisterské studium

3.2 Official length of programme / Standardní délka programu: semesters / semestrů: 4, credits / kreditů: 120

3.3 Access requirements / Požadavky na přístup ke studiu: Bachelor degree / Absolvování bakalářského studijního pro-

° gramu

4. Information on the contents and results gained / Informace o obsahu a dosažených výsledcích
4.1 Form of study / Forma studia: Full-time / Studijní formu

4.2 Programme requirements / Požadavky v rámci programu:

Course "Information Technology" prepares students to be experts in the fields of computer sciences and communication technology. Particular emphasis is put on modern programming methods, databases, digital signal processing, networking and computer hardware.

V rámci studia oboru “Informační technologie” se studenti seznamí s teorií, technologiemi a postupy používanými ve výpočetním a komunikační technice. Studenti se mají naučit vyučené předměty digitálněho zpracování informací a tak se ovládatí v praxi v rámci programovacího techniky, úprav výpočetního systému a využití v rámci pokročilých technologií.

4.3 Programme details and the individual grades / credits obtained / Podrobné údaje o programu a jednotlivých dosažených hodocených kreditech:

<table>
<thead>
<tr>
<th>Code</th>
<th>Kód předmětu</th>
<th>Subject / Název předmětu</th>
<th>Date</th>
<th>Datum</th>
<th>Exam mark / Závěrečná</th>
<th>Credits / Kredity</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>KAP/ULA</td>
<td>Introduction to Linear Algebra and Discrete Mathematics / Úvod do lineární algebry a diskrétní matematiky</td>
<td>10.01.2005</td>
<td>3 P</td>
<td>7</td>
<td>Czech</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KES/CIB</td>
<td>Digital Electronics / Číslicová elektronika</td>
<td>10.01.2005</td>
<td>1 P</td>
<td>5</td>
<td>Czech</td>
<td></td>
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</tr>
<tr>
<td>KMF/MAT*1M</td>
<td>Mathematics I / Matematika 1</td>
<td>10.01.2005</td>
<td>3 P</td>
<td>7</td>
<td>Czech</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Study Programme Guide „Engineering of Interactive Systems“

<table>
<thead>
<tr>
<th>Code</th>
<th>Subject/Název předmětu</th>
<th>Date</th>
<th>Exam mark</th>
<th>Credits</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>KMD/MA2P2M</td>
<td>Mathematics / Matematika 2</td>
<td>10.01.2005</td>
<td>3 P</td>
<td>6</td>
<td>Czech</td>
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<tr>
<td>KSI/CF</td>
<td>Digital Computers / Číselné počítače</td>
<td>10.01.2005</td>
<td>1 P</td>
<td>5</td>
<td>Czech</td>
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<tr>
<td>KSI/GDA</td>
<td>Graphic and Database Applications / Grafické a databázové aplikace</td>
<td>10.01.2005</td>
<td>2 P</td>
<td>4</td>
<td>Czech</td>
</tr>
<tr>
<td>KSI/OPS</td>
<td>Operating Systems / Operační systémy</td>
<td>10.01.2005</td>
<td>3 P</td>
<td>5</td>
<td>Czech</td>
</tr>
<tr>
<td>KSI/PRG</td>
<td>Computer Graphics / Počítačová grafika</td>
<td>10.01.2005</td>
<td>1 P</td>
<td>5</td>
<td>Czech</td>
</tr>
<tr>
<td>KSI/PPR</td>
<td>Programming Tools / Prostory pro programování</td>
<td>10.01.2005</td>
<td>3 P</td>
<td>5</td>
<td>Czech</td>
</tr>
<tr>
<td>KSI/PRG</td>
<td>Programming / Programování</td>
<td>10.01.2005</td>
<td>3 P</td>
<td>5</td>
<td>Czech</td>
</tr>
<tr>
<td>KAI/PST</td>
<td>Computer Networks / Počítačové sítě</td>
<td>11.01.2005</td>
<td>1 P</td>
<td>5</td>
<td>Czech</td>
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<tr>
<td>KAP/DIM</td>
<td>Calculus 3 / Matematika 3</td>
<td>21.01.2005</td>
<td>3</td>
<td>5</td>
<td>Czech</td>
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<tr>
<td>KMD/MA3P3M</td>
<td>Calculus 3 / Matematika 3</td>
<td>31.01.2005</td>
<td>2</td>
<td>5</td>
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<tr>
<td>KES/SII</td>
<td>Signals and Information / Signály a informace</td>
<td>04.02.2005</td>
<td>3</td>
<td>6</td>
<td>Czech</td>
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<tr>
<td>KES/ARS</td>
<td>Architecture / Architektura počítačů</td>
<td>18.05.2005</td>
<td>2</td>
<td>5</td>
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<tr>
<td>KSI/JRQ</td>
<td>Computers and Microcomputers / Počítače a mikropočítače</td>
<td>08.06.2005</td>
<td>2</td>
<td>5</td>
<td>Czech</td>
</tr>
<tr>
<td>KES/NHK</td>
<td>Design of Hardware Components / Návrh hardwarových komponent</td>
<td>20.06.2005</td>
<td>2</td>
<td>5</td>
<td>Czech</td>
</tr>
<tr>
<td>KSI/CGA</td>
<td>Grammatik and Algorithms / Gramatiky a algoritmy</td>
<td>28.06.2005</td>
<td>1</td>
<td>5</td>
<td>Czech</td>
</tr>
<tr>
<td>KSI/JPS</td>
<td>Control Computer Systems / Řídicí počítačové systémy</td>
<td>19.01.2006</td>
<td>3</td>
<td>5</td>
<td>Czech</td>
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<tr>
<td>KES/PSI</td>
<td>Computer-based Signal Processing / Počítačové zpracování signálů</td>
<td>31.01.2006</td>
<td>2</td>
<td>5</td>
<td>Czech</td>
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<tr>
<td>KES/IAP</td>
<td>Human-Computer Interaction / Interakce člověka s počítačem</td>
<td>08.02.2009</td>
<td>2</td>
<td>5</td>
<td>Czech</td>
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<tr>
<td>KSI/JWW</td>
<td>Programming for WWW / Programování pro WWW</td>
<td>03.05.2006</td>
<td>1</td>
<td>5</td>
<td>Czech</td>
</tr>
<tr>
<td>KSI/PHV</td>
<td>Using Information Resources / Použití informačního zdroje</td>
<td>15.05.2006</td>
<td>2</td>
<td>5</td>
<td>Czech</td>
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<tr>
<td>KSI/OPV</td>
<td>Problems of Optimization / Optimalizační otázky</td>
<td>06.07.2006</td>
<td>3</td>
<td>5</td>
<td>Czech</td>
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<tr>
<td>KSI/JRO</td>
<td>Intelligent Robotics / Inteligentní robotika</td>
<td>08.06.2006</td>
<td>3</td>
<td>5</td>
<td>Czech</td>
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<tr>
<td>KAI/MMP</td>
<td>Modern Programming Methods / Moderní přístupy k programování</td>
<td>15.09.2006</td>
<td>2</td>
<td>5</td>
<td>Czech</td>
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<tr>
<td>KAI/PRE</td>
<td>Compilers / Prekladače</td>
<td>15.09.2006</td>
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<td>4</td>
<td>Czech</td>
</tr>
<tr>
<td>KAI/PSA</td>
<td>Programming of Network Applications / Programování síťových aplikací</td>
<td>15.09.2006</td>
<td>3</td>
<td>5</td>
<td>Czech</td>
</tr>
<tr>
<td>KSI/DBB</td>
<td>Database Systems / Knižní databáz</td>
<td>10.10.2006</td>
<td>3</td>
<td>5</td>
<td>Czech</td>
</tr>
<tr>
<td>KAI/DST</td>
<td>Diploma Seminar / Diplomový seminář</td>
<td>02.05.2007</td>
<td>2</td>
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<td>KDF/PRO</td>
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<tr>
<td>KAP/IME</td>
<td>Combinatorial Methods / Kombinátorické metody</td>
<td>20.05.2007</td>
<td>3</td>
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#### Final State Examination / Státní závěrečná zkouška

<table>
<thead>
<tr>
<th>Date</th>
<th>Exam mark</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>Czech</td>
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</tbody>
</table>

#### 4.4 Grading scheme and, if available, grade distribution guidance / Klasifikační stupnice a vysvětlení jejího významu:

<table>
<thead>
<tr>
<th>ECTS grade/stupeň</th>
<th>Exam Mark</th>
<th>Grade známka slova</th>
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<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>výborně dobro</td>
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<tr>
<td>B</td>
<td>1-</td>
<td>výborně mínus</td>
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<tr>
<td>C</td>
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<td>velmi dobro</td>
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<tr>
<td>D</td>
<td>2-</td>
<td>velmi mínus</td>
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<tr>
<td>E</td>
<td>3</td>
<td>dobro</td>
</tr>
<tr>
<td>F</td>
<td>4</td>
<td>nepropálo</td>
</tr>
</tbody>
</table>

#### R - Satisfactory completion of course, no grade / Předmět splnil |

#### P - Exam was passed in previous study / Uznáno předmět |

#### B - Bachelor studies / Bakalářské studium, |

#### M - Master studies / Magisterské studium |

#### D - Doctoral studies / Doktorské studium |

#### C - Líčení studies / Obhajobní studium |

#### 4.5 Overall classification of the qualification / Celková klasifikace kvalifikace: Passed / Prospěl

### 5. Information on the function of the qualification / Informace o funkci kvalifikace

#### 5.1 Access to further study / Přístup k dalšímu studiu: Doctoral study programme / Doktorský studijní program |

#### 5.2 Professional status conferred / Profesní postavení: Engineer / Ingénýr |

This study course is intended for bachelor’s degree holders in engineering, informatics, natural sciences and related fields. Students obtain deep theoretical knowledge and practical skills necessary to cope successfully with complex tasks that often require unconventional and highly sophisticated approaches and methods. Studijní obor je určen pro absolventy bakalářských studií, zaměřených na techniku, informatici, přírodní vědy a s tím související oblasti. Studenci získají hluboké teoretické znalosti a praktické dovednosti nezbytné k úspěšnému řešení úkolů, kde použité metody často vyžadují nekonvenční a výsycce sofistikovaný přístup k řešení.

### 6. Additional information / Doplňkové informace

#### 6.1 Additional information / Doplňkové informace: |

#### 6.2 Further information sources / Další informační zdroje: |


### 7. Certification of supplement / Potvrzení dodatku

#### 7.1 Date / Datum:

#### 7.2 Signature / Podpis: |

#### 7.3 Capacity / Funkce: dean of Faculty of Mechatronics and Interdisciplinary Engineering Studies |

děkan Fakulty mechatroniky a mezioborových inženýrských studii |

#### 7.4 Official stamp or seal / Oficiální razítko nebo počet:
4.2 Sample diploma issued by the Paul Sabatier University of Toulouse