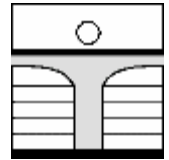


## **Příloha č. 1**

**k žádosti o prodloužení akreditace  
navazujícího magisterského studijního  
oboru „Mechatronics“ na Fakultě  
mechatroniky, informatiky a  
mezioborových studií**

**Master Study Program Guide „Mechatronics“**



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

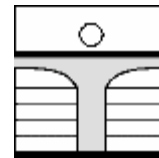
**and**

**HS Zittau/Görlitz,  
Faculty Electrical Engineering and Computer Science**

# **Master Study Program Guide “Mechatronics”**



**September 2009**



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

**and**

**HS Zittau/Görlitz,  
Faculty Electrical Engineering and Computer Science**

# **Master Study Program Guide “Mechatronics”**



**Mechatronics systems**

**Liberec 2009**

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# 1 Preface

The study program “**Mechatronics**” is based on joint cooperation of Technical University of Liberec (TU Liberec), Faculty of Mechatronics, Informatics and Interdisciplinary Studies (Faculty FM) and HS Zittau/Görlitz, Faculty Electrical Engineering and Computer Science (Faculty F-EI).

These are the **Partner Universities**. Applicants for this study program were matriculated at HS Zittau/Görlitz or TU Liberec. The university, where a student got his first Matriculation, is called “**Home University**”. The respectively other Partner University is called “**Host University**”. During his stay at the Host University, the student is registered at the “Host University” and matriculated at the “Home University”.

The main objective of this new joint study program “**Mechatronics**” is to connect the great diversity of mechatronics expertise at the TU Liberec and HS Zittau/Görlitz to a common higher education platform in the European Region Nisa according the Bologna Declaration. European and TU Liberec and HS Zittau/Görlitz students with bachelor’s degree will in the framework of master study “Mechatronics” have the possibility to study mechatronics science. They will be fully integrated into research projects and cooperation with the regional industry at both higher education institutions. Students will take part in design and development of new engineering products and processes by integration of electronic and electrical engineering, computer technology and control engineering

Another objective is to given the students cross-disciplinary extension from the laboratories and computer environment to industrial and research projects and gaining international experience, acquiring the English language and picking up a new culture lifestyle along with their qualification of course.

Study master in “Mechatronics” will bring benefits to European Region Nisa and European industry because of the graduates will be familiar with the specific features of region and host countries.

## 2 Master Course Structure and Modules

The Fig.1 determines the pattern of the semesters for the master study in Mechatronics.

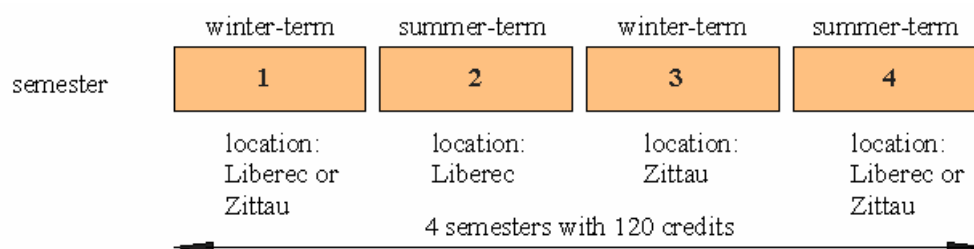


Fig.1 Pattern of the semesters for the Master in Mechatronics.

### 2.1 First semester

#### 2.1.1 Winter Term, Study load, Credits

The first semester is a preparatory one and is valued at minimum of 30 ECTS (see 3.4.2). The bachelor’s degrees valued in 210 ECTS are recognized as the preparatory first semester and students with such one can enter direct the second semester of master study in Mechatronics [see 3.5.1 (3.)]. The modules to be taken by students registered at TU Liberec are given in the Table 1

| Table 1. Semester: 1. (winter) |                                           |                                                                                                                                                      |  |                     |                  |
|--------------------------------|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|--|---------------------|------------------|
| TU Liberec                     |                                           |                                                                                                                                                      |  |                     |                  |
| Nr.                            | Subject names                             |                                                                                                                                                      |  | Study load/<br>ECTS | Exami-<br>nation |
| Obligatory Subjects            |                                           |                                                                                                                                                      |  |                     |                  |
| 1                              | Applied Mathematics                       | Maryška J. <a href="mailto:jiri.maryska@tul.cz">jiri.maryska@tul.cz</a><br>Šembera J. <a href="mailto:jan.sembera@tul.cz">jan.sembera@tul.cz</a>     |  | 3+3 / 6             | WO               |
| 2                              | Probability and Statistics-N              | Březina J. <a href="mailto:jan.brezina@matfyz.cz">jan.brezina@matfyz.cz</a>                                                                          |  | 2+1/ 4              | CC               |
| 3                              | Continuum Mechanics<br>and Thermodynamics | Hokr M. <a href="mailto:milan.hokr@tul.cz">milan.hokr@tul.cz</a>                                                                                     |  | 2+2 /4              | WO               |
| 4                              | Electromagnetic Field and<br>Optics       | Richter A. <a href="mailto:ales.richter@tul.cz">ales.richter@tul.cz</a><br>Kopecký V. <a href="mailto:vasek.kopecky@tul.cz">vasek.kopecky@tul.cz</a> |  | 2+2 / 6             | W                |
| 5                              | Electric drives                           | Kubín.J <a href="mailto:jiri.kubin@tul.cz">jiri.kubin@tul.cz</a>                                                                                     |  | 3+2 / 5             | WO               |
| 6                              | Laboratory I                              | Potěšil A. <a href="mailto:antonin.potesil@tul.cz">antonin.potesil@tul.cz</a>                                                                        |  | 0+4 / 5             | CC               |

Type of Examination: W – written, O – oral, WO – written and oral, CC – Classified credit

## 2.1.2 Modules annotation

### Applied Mathematics

The aim of the course is to give a mathematical basis for other courses of MSc studies. The core subject topics are

- Basics of functional analysis
- Hilbert and Banach spaces, Sobolev spaces,
- Systems of ordinary differential equations
- Runge - Kutta methods, Selected numerical methods
- Partial differential equations, finite difference method.

### Probability and Statistics

The module provides a comprehensive overview of engineering probability and statistics. It is focused mainly on

- Probability distribution functions, parameter estimates, hypothesis testing
- Regression analysis, analysis of variance
- Classification methods
- Bayesian methods
- Random processes, Markov chains
- Monte Carlo Methods

### Continuum Mechanics and Thermodynamics

The aim of the course is to provide understanding of the basic principles of physics and of their applications to typical engineering problems in continuum mechanics and thermodynamics.

- Stress and strain tensors with interpretation, principal values and directions, generalizes
- Hooke's law, Equations and formulation of boundary value problems in elasticity, technical problems - bending and torsion.
- First and second law of thermodynamics, basic quantities and equations.

### Electromagnetic Field and Optics

Course aim is to give mathematical bases of electromagnetic fields and electromagnetic theory of light. After completion of this module students will be familiarized with

- Theory electrical circuits, lumped and distributed electrical circuits
- Maxwell's equations, static electric field, time-varying fields, electromagnetic waves

- Transient response of transmission lines
- Optics– electromagnetic theory of light, wave equation in homogeneous and inhomogeneous medium, monochromatic electromagnetic waves
- Helmholtz equation, interference and multiple interference
- Fourier optics – optical Fourier transformation, diffraction, holography.

### Electric drives

The aim of the subject is to give to students, theoretic and practical knowledge about overall arrangement, function and characteristic properties of basic parts of electric drives in the technologic systems:

- Electrical drives – configuration, requirements on electric and working machines
- Kinematics of electric drives, losses and dimensioning
- Analyze of regulating systems, control algorithms, optimization of systems
- DC motors - properties, mathematical models, control of velocity and simulation
- AC motors – properties, mathematical modeling, control of velocity and simulation
- Power semiconductor converters, properties and characteristic
- Components of control circuits
- Electric drives in the distributed control system.

### Laboratory I

Objective of the course is to introduce laboratory technology planning used for characteristics identification and electromagnetic systems responses to students. The laboratory topics are

- The theory and practical solutions of variety of experimental work and functional telemetry
- The demonstration of measuring chains used in experimental and developing units of industrial subjects and engineering companies.

## 2.2 Second Semester

### 2.2.1 Summer semester, Study load, Credits

The modules to be taken by students in the summer term are given in the Table 2. Minimal one subject of obligatory elective subjects has to be chosen! Minimum number of students in an obligatory elective subject has to be 6.

| Table 2. Semester: 2. (summer) |                                 |                |                                                                        |                  |                  |
|--------------------------------|---------------------------------|----------------|------------------------------------------------------------------------|------------------|------------------|
| TU Liberec                     |                                 |                |                                                                        |                  |                  |
| Nr.                            | Subject names                   |                |                                                                        | Study load/ ECTS | Exami-<br>nation |
| Obligatory Subjects            |                                 |                |                                                                        |                  |                  |
| 1                              | Robotics                        | Záda V.        | <a href="mailto:vaclav.zada@tul.cz">vaclav.zada@tul.cz</a>             | 2+2 / 5          | WO               |
| 2                              | Programmable Controllers        | Tůma P.        | <a href="mailto:petr.tuma@tul.cz">petr.tuma@tul.cz</a>                 | 2+2 / 5          | WO               |
|                                |                                 | Díblík M.      | <a href="mailto:martin.diblik@tul.cz">martin.diblik@tul.cz</a>         |                  |                  |
| 3                              | Drives and Servomechanisms      | Rydlo P.       | <a href="mailto:pavel.rydlo@tul.cz">pavel.rydlo@tul.cz</a>             | 2+2 / 5          | WO               |
|                                |                                 | Černohorský J. | <a href="mailto:josef.cernohorsky@tul.cz">josef.cernohorsky@tul.cz</a> |                  |                  |
| 4                              | Control Systems in Mechatronics | Modrlák O.     | <a href="mailto:osvald.modrlak@tul.cz">osvald.modrlak@tul.cz</a>       | 2+2 / 5          | WO               |
| 5                              | Semester Project                |                |                                                                        | 0+4 / 5          | CC               |

| Obligatory elective Subjects |                                      |                            |                                                                                                                                      |         |    |
|------------------------------|--------------------------------------|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------|---------|----|
| 1                            | Digital Signal Processing 1          | Koldovský Z.               | <a href="mailto:Zdenek.koldovsky@tul.cz">Zdenek.koldovsky@tul.cz</a>                                                                 | 2+2/5   | CC |
| 2                            | Smart Sensors and Actuators          | Nosek J.<br>Mokřý P.       | <a href="mailto:jaroslav.nosek@tul.cz">jaroslav.nosek@tul.cz</a><br><a href="mailto:pavel.mokry@tul.cz">pavel.mokry@tul.cz</a>       | 2+2/5   | WO |
| 3                            | Laboratory 2                         | Potěšil A.<br>Koprnický J. | <a href="mailto:antonin.potesil@tul.cz">antonin.potesil@tul.cz</a><br><a href="mailto:jan.koprnický@tul.cz">jan.koprnický@tul.cz</a> | 0+4 / 5 | CC |
| 4                            | Design of the Electrotechnic Systems | Novák M.<br>Plíva Z.       | <a href="mailto:miroslav.novak@tul.cz">miroslav.novak@tul.cz</a><br><a href="mailto:zdenek.pliva@tul.cz">zdenek.pliva@tul.cz</a>     | 2+2 / 5 | WO |
| 5                            | Hardware Software Codesing           | Novák O.<br>Plíva Z.       | <a href="mailto:ondrej.novak@tul.cz">ondrej.novak@tul.cz</a><br><a href="mailto:zdenek.pliva@tul.cz">zdenek.pliva@tul.cz</a>         | 2+2 / 5 | WO |

Type of Examination: W – written , O – oral, WO – written and oral, CC – Classified credit

## 2.2.2 Modules annotation

### Robotics

The subject *Robotics* is oriented to deep student knowledge in the problems of analysis and control of robot manipulators with using sensors.

- Matrix methods of kinematics of robot manipulators, quaternion methods.
- Direct and inverse kinematics, using analytical and numerical methods.
- Dynamics of robots, differential equations of motion, matrix methods.
- Using kinematics and dynamical equations for robots control from point to point.
- Robot motion control on defined trajectories or surfaces, classical trajectory robot planning.
- Adaptive and adaptive-learning iterative control in robotics.
- Numerical solutions of robots dynamics and simulations of robot motions.

### Programmable Controllers

The module provides a comprehensive overview of programmable control systems with accent on Programmable Logical Controllers and communication in networks.

After completion the students should

- Acquire good knowledge and overview of implemented hardware and systems
- Be familiar with the modern languages and software (STEP 7)
- Good knowledge about communication in networks
- Be familiar with fundamental approach to industrial implementation
- Implementation of hybrid control

### Drives and Servomechanisms

Students acquire knowledge of basic principles of electrical drives, basic knowledge of servomechanisms like servo systems, drive and motion controllers and industrial communication networks used in motion control. Students will be familiarized with

- Characteristics of drives and usage of drive in industry
- Control structure of servo drives for torque, speed, position mode, master slave, electronic gearbox and electronic cams
- Pulse width modulation
- Sensor less speed control, direct torque control, speed and position sensors
- Industrial bus systems, controlling systems, drive tuning

### Control systems in Mechatronics

The module provides a comprehensive overview of control systems with accent on an appropriate balance between theoretical concepts and engineering practice in analysis, synthesis and identification of dynamic systems. After completion the students should

- Acquire good knowledge of practical parameter estimation for determined model structure
- Apply design methods of single loop control and it's enhancements
- Understand fundamental approach to robust control
- Be familiar with description of multi input multi output systems
- Be familiar with the modern software tools MATLAB for analysis and synthesis.

### **Semester Project**

1. Semester projects are announced by institutes at the TU Liberec or HS Zittau/Görlitz from begin to the end of summer term.
2. Students have to pick one.
3. The last date for project assigning is given by notice of the dean.
4. Project will be assigned by the chief of the project in writing.
5. Project has to be closed by project defense. The date of project defenses is given by notice of the dean.

### **Digital Signal Processing 1**

The main goal of this course is to deepen student's knowledge in the field of digital signal processing. It is focused mainly on

- Digital filter design methods,
- Transformation of single and/or multidimensional signals (FFT, DCT)
- Processing of random signals
- Identification and modeling of random processes.

### **Electrical Transducers of the Physical Quantities**

In this subject, there will be given the both theoretical overview and practical experience in the area of selected electric transducers of physical quantities. After completion of this module the students should know about:

- Smart materials and their fabrication
- Piezoelectric wide band (aperiodic) and resonant transducers
- Piezoelectric resonators and their applications
- Piezoresistive transducers,
- Smart sensors and actuators, and an overview of modern trends in the design of electrical transducers based on the application of ferroelectric thin films including processing of micro-electro-mechanical systems (MEMS),
- Design of complex mechatronics systems.

### **Laboratory II**

The objective of the advanced course is to introduce laboratory technology planning used for characteristics identification and electromagnetic systems responses to students. Through suitably chosen laboratory topics the theory and practical solutions of a variety of experimental work and functional telemetry is introduced to students. Practice:

- Laboratory of car electronic systems
- Research Laboratory of VUTS Liberec (Research Institute of Textile Machines Liberec Co.)

### **Design of the electrotechnics systems**

This subject teaches students necessary theory of electrotechnics needed for design of distribution boards and electrical equipment of machines and buildings.

- CAD/CAE/CAM systems at electrotechnics
- Electrotechnics legislative and standards

- Conductor and cable design
- Protection devices, design, selectivity of protection
- Over voltage protections
- Switchboard parts, control parts, measuring devices over supplies, properties of low voltage power net
- Switch board cooling, thermal behavior

### Hardware Software Codesing

Course aim 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 behavioral description
- H/S cooperation, algorithms partitioning tasks into hardware and software.
- Simulation, synthesis and verification techniques
- In labs, student will use FPGA circuits and Xilinx or Mentor design tools.

## 2.3 Third Semester

### 2.3.1 Winter semester, Study load, Credits, Form of Examination

The modules to be taken by students in the third term at HS Zittau/Görlitz are given in the Table 3. Minimal one subject of obligatory elective subjects and the mechatronical Project has to be chosen! Minimum number of students in an obligatory elective subject has to be 6.

| Table 3. Semester: 3. (winter)                         |                                   |             |                                                                  |                   |                  |
|--------------------------------------------------------|-----------------------------------|-------------|------------------------------------------------------------------|-------------------|------------------|
| HS Zittau/Görlitz                                      |                                   |             |                                                                  |                   |                  |
| Nr.                                                    | Subject names                     |             |                                                                  | Study load / ECTS | Exami-<br>nation |
| Obligatory Subjects                                    |                                   |             |                                                                  |                   |                  |
| 1                                                      | Automatic Control Technology      | Proske D.   | <a href="mailto:d.proske@hs-zigr.de">d.proske@hs-zigr.de</a>     | 2+2 / 5           | C/W 180          |
| 2                                                      | Fuzzy - Control                   | Kästner W.  | <a href="mailto:w.kaestner@hs-zigr.de">w.kaestner@hs-zigr.de</a> | 2+2 / 5           | W 150            |
| 3                                                      | Image Processing                  | Bischoff S. | <a href="mailto:s.bischoff@hs-zigr.de">s.bischoff@hs-zigr.de</a> | 2+2 / 5           | W 150            |
| 4                                                      | Digital Communication Technologie | Vogt J.     | <a href="mailto:j.vogt@hs-zigr.de">j.vogt@hs-zigr.de</a>         | 2+2 / 5           | W 120            |
| 5                                                      | Digital Signal Processing 2       | Thiele R..  | <a href="mailto:r.thiele@hszigr.de">r.thiele@hszigr.de</a>       | 2+2 / 5           | W 120            |
| Obligatory elective Subjects and Mechatronical Project |                                   |             |                                                                  |                   |                  |
| 1                                                      | Magnetic Bearings                 | Worlitz F.  | <a href="mailto:f.worlitz@hs-zigr.de">f.worlitz@hs-zigr.de</a>   | 2+2 / 5           | 2 x W            |
| 2                                                      | Hardware Programming              | Kühne S.    | <a href="mailto:st.kuhne@hs-zigr.de">st.kuhne@hs-zigr.de</a>     | 2+2 / 5           | W                |
| 3                                                      | Wind and Water Power              | Weise V.    | <a href="mailto:v.weise@hs-zigr.de">v.weise@hs-zigr.de</a>       | 2+2 / 5           | O                |

Type of Examination: W – written, O – oral, WO – written and oral, CC – Classified credit,  
C – Credit,

### 2.3.2 Modules annotation

#### Automatic Control Theory

In the course students learn about modern methods of Automatic Control. Accent will be put on practical use and implementation of these methods. Students will acquire knowledge of

- Analysis of controlled systems by state space description
- State Estimation
- Synthesis of state space controller

- Multi loop control design
- Digital control

### **Fuzzy – Control**

The aim of this course is to give consolidated knowledge about fuzzy set theory, fuzzy systems and their application in control theory. Main topics are:

- Foundations of fuzzy set theory
- Fuzzy systems and their components, Fuzzy system of Mamdani type (structure, example of demonstration, practical realization, software tool DynStar)
- Fuzzy system of Takagi-Sugeno-Kang type (structure, example of demonstration, practical realization, analogy to Artificial Neural Networks)
- requirements for application in control theory (consideration of dynamic components)
- development of fuzzy controller
- application of fuzzy controller and comparison to classical controller

### **Image Processing**

This course provides a general introduction to the fundamental techniques of computer vision and image processing and illustrates their practical application. The main topics are:

- Image acquisition and representation
- Preprocessing methods: transformations of pixel brightness and geometry, camera calibration, local operators
- Video and audio compression
- Image segmentation
- Feature extraction: color, texture and shape descriptors; Principal Component Analysis
- Classification: prototypes, cluster analysis, statistical methods, classifiers
- Teachable image evaluation: supervised and non-supervised learning, neural networks, Support-Vector-Machine (SVM)
- Multi-sensor technology, Fusion
- Current practical application areas

### **Digital Communication Technology**

Digital communications systems have seen tremendous developments throughout the past decade. Particularly improvements in signal processing, source and channel coding have lead to high data rates via cable and wireless.

In this course the basics of modern communication systems are highlighted, especially source coding, channel coding, cryptography and adaptive filters.

Source coding is the optimal representation of information. Channel coding means generation of signals which are robust against channel distortions.

Cryptography is the theory of hiding information. In this course modern principles as symmetric and asymmetric methods are shown.

Adaptive filters are widely used in digital communication and control systems.

In the course the basics of analysis and synthesis of adaptive systems as transversal filters or lattice structures are developed. The students get information about the mathematical description of least mean squares- and recursive least squares algorithms. The convergence and stability analysis with design rules are also shown.

### **Digital Signal Processing II**

In this course, the basics of digital signal processing are developed.

This is time-based signals and systems, a mathematical description of signals and systems in the time, frequency and screen domain, including totals and integral transformations. The main emphasis here is the discrete and Fast Fourier transform for signal and system analysis. Another subject of Education is the design of recursive and non-recursive digital filters also wave digital filters. For this purpose both the Impulse-Invariance and Bilinear method, the Fourier approximation and the wave description to the design of digital filters conveys.

### **Magnetic Bearings**

The aim of the subject is to provide knowledge and requirements for design and application of magnetic bearings. The main topics of lectures are:

- Kinds of magnetic bearings
- Design and engineering
- Control theory
- Diagnosis possibilities
- Applications

### **Hardware Programming**

This subject provides a study of modern hardware programming. The focus is led on

- Hardware of 8-Bit Microcontrollers (architecture, special function registers, bus-system, reset-logic, pin-layout, timers,
- ANSI standard C language programming, Program development in ANSI C with  $\mu$ VISON2
- Interrupt-controlling, interrupt-priorities, mask cable Interrupts
- Hardware description of the real time clock DS12887
- Integration of hardware expansions
- Using of the printed board software EAGLEe from the German company CADSOFT
- Routing and board-design of printed-circuit boards
- Assembling and fitting of the printed board
- Soldering and commissioning of the printed board
- Test of the developed board with software routines

### **PLC – programming**

The aim of the module is to provide study of modern methods for programming of PLC. Students will acquire knowledge for programming of logic control and digital control and about the use of PLC to realize these methods for industrial control.

### **Wind and Water Power**

The aim of the course is to provide knowledge of utilization the wind and water power. The module contains follow parts:

- Wind energy and conversion, system components of wind energy converters, power control of wind energy converters
- Economical aspects and Environmental of wind energy utilization
- Principles of water turbines and their properties, System components of water power stations, Electricity generation and grid linkage for water power stations
- Economical aspects and Environmental of water power

## 2.4 Fourth Semester

### 2.4.1 Summer semester, Study load, Credits

The students will do their Master Thesis work at chosen higher education institution, which are TU Liberec or HS Zittau/Görlitz [Details see 3.3.2].

Students registered at HS Zittau/Görlitz have their Diploma Thesis work valued at 30 ECTS during the fourth semester. They are working on their Diploma Thesis in the Industry without any subjects (see Table 4.) [Details see 3.3.2 (2.)].

Students registered in the fourth semester at TU Liberec have their Diploma Thesis work valued at 12 ECTS and Diploma Colloquium at 3 ECTS. Further they have to take 3 obligatory elective subjects valued altogether at 15 ECTS that are shown in the Table 4. During the fourth semester they will have 30 ECTS [Details see 3.3.2 (2.)].

| <b>Table 4 Semester: 4. (summer)</b> |                                                                                                                                                                                              |                          |                    |                                     |                          |
|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|--------------------|-------------------------------------|--------------------------|
| <b>TU Liberec</b>                    |                                                                                                                                                                                              |                          |                    | <b>HS Zittau/Görlitz</b>            |                          |
| <b>Nr.</b>                           | <b>Subject names</b>                                                                                                                                                                         | <b>Study load / ECTS</b> | <b>Examination</b> | <b>Subject names</b>                | <b>Study load / ECTS</b> |
| <b>Obligatory Subjects</b>           |                                                                                                                                                                                              |                          |                    | <b>Obligatory Subjects</b>          |                          |
| 1                                    | <b>Diploma Seminar</b><br>Richter A. <a href="mailto:ales.richter@tul.cz">ales.richter@tul.cz</a>                                                                                            | 0+3 / 3                  | CC                 | <b>Diploma thesis</b>               | 0+15/30                  |
| 2                                    | <b>Diploma Thesis</b> Supervisor                                                                                                                                                             | 0+12 / 12                | C                  |                                     |                          |
| <b>Obligatory elective Subjects</b>  |                                                                                                                                                                                              |                          |                    | <b>Obligatory elective Subjects</b> |                          |
| 1                                    | <b>Technical Diagnostics</b><br>Jaksch I. <a href="mailto:ivan.jaksch@tul.cz">ivan.jaksch@tul.cz</a>                                                                                         | 2+2 / 5                  | WO                 |                                     |                          |
| 2                                    | <b>Intelligent Robots</b><br>Záda V. <a href="mailto:vaclav.zada@tul.cz">vaclav.zada@tul.cz</a>                                                                                              | 2+2 / 5                  | WO                 |                                     |                          |
| 3                                    | <b>Digital Image Processing</b><br>Chaloupka J. <a href="mailto:josef.chaloupka@tul.cz">josef.chaloupka@tul.cz</a><br>Matela L. <a href="mailto:lukas.matela@tul.cz">lukas.matela@tul.cz</a> | 2+2 / 5                  | W                  |                                     |                          |
| 4                                    | <b>Control systems of Vehicles</b><br>Malý M. <a href="mailto:miroslav.maly@tul.cz">miroslav.maly@tul.cz</a>                                                                                 | 2+2 / 5                  | WO                 |                                     |                          |
| 5                                    | <b>Human-computer Interaction</b><br>Drábková J. <a href="mailto:jindra.drabkova@tul.cz">jindra.drabkova@tul.cz</a>                                                                          | 2+2 / 5                  | WO                 |                                     |                          |
| 6                                    | <b>Control Methods in Applications</b><br>Hlava J. <a href="mailto:jaroslav.hlava@tul.cz">jaroslav.hlava@tul.cz</a>                                                                          | 2+2/5                    | WO                 |                                     |                          |

Type of Examination: W – written, O – oral, WO – written and oral, CC – Classified credit, C – Credit,

### 2.4.2 Modules annotation

#### Diploma thesis

1. Working out of Diploma thesis
2. Consulting with Supervisor and Experts from Industry and Research Institution

#### Diploma Colloquium

- 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

### **Technical Diagnostics**

The subject deals with industrial technical diagnostics methods including advanced method of signal processing

- Diagnostics models. System reliability. Statistics methods. Expert systems
- Analysis of diagnostic signals in time and frequency domain.
- Cyclical machine and sound diagnostics.
- Hilbert transform and its use in diagnostics. Modulation and demodulation.
- Vibro-diagnostics systems. Accelerometers. Spectral analysis.

### **Intelligent Robots**

The subject *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.

### **Digital Image processing**

The subject Digital Image processing is focused on student's ability to understand basic principles of computer image processing and recognition. The main content of this subject is:

- Digital cameras, lenses, digitized image, sampling, quantization.
- Image pre-processing and transformation
- Local preprocessing: image smoothing, edge detectors.
- Mathematical morphology
- Skeletons and object marking, segmentation
- Region identification and object recognition.

### **Measurement and Diagnostic of Machines**

The subject *Measurement and Diagnostic of Machines* compiles knowledge obtained in other courses in order to offer insight into theory and praxis behind automated measurement and diagnostics in technical plant.

- Measuring chain and its role in control a diagnostics.
- Signal theory, transformation, sampling
- Integral transformations, Fourier transformation, Laplace transformation, Z-transformation and wavelet transformation.
- Machine diagnostics - vibration diagnostics, modal analysis, multiple criterion based diagnostic.
- Design of weighting sensor with digital output.

### **Control systems of vehicles**

The subject is focused to fundamental properties of driving system elements and its parts. The module contains follow parts:

- Drive train, function, design, diverting elements, transmissions
- Hydrostatic transmission of mobile machines
- Vehicle systems: Steering, Braking, Stabilization, Antilock and Control systems
- Safety systems, information and communication.

### **Human-computer Interaction**

The subject /Human-Computer Interaction/ offers the overview of design of virtual environments (3D objects) with interactive components.

- Introduction of VRML, Navigation, Shapes, Appearance
- Special nodes, Variable types, Prototypes
- Sensors
- Animations
- Scripts

### **Control methods in applications**

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 behavior and interaction of continuous and logical controls
- hybrid control

## **3 Policy and Legal Procedures**

### **3.1 Common boards**

1. The Faculty of Mechatronics, Informatics and Interdisciplinary Studies of TU Liberec and the Faculty Electrical Engineering and Computer Science of HS Zittau/Görlitz created common **“Board - Master of Mechatronics”** in Liberec, **January 28. 2008**. This board authorizes organization structure and administration rules of the study program “Master in Mechatronics” at both faculties.
2. “Board Master in Mechatronics“ is governed by deans of both faculties: Faculty of Mechatronics, Informatics and Interdisciplinary Studies and the Faculty Electrical Engineering and Computer Science and includes two members of each faculty that are appointed by Vice rector of study at HS Zittau/Görlitz and at TU Liberec by the dean of Faculty of Mechatronics, Informatics and Interdisciplinary Studies.
3. The both dean of Home Universities will create the **“State Final Examination Boards of Mechatronics”** and **“Admission Board of Mechatronics”** and they have the right to appoint the members of both boards from both faculties.

### **3.2 Students**

1. The study program master in “Mechatronics” is determined for students TU Liberec and HS Zittau/Görlitz, European and Third-country students.
2. The number of students is supposed to be about 25 Master’s students (10 TU Liberec, 10 HS Zittau/Görlitz and 5 European).
3. Possibly there will be an increase in the amount of European and Third-country students.

### 3.3 Study structure

#### 3.3.1 Place of Hosting University

1. In each semester all students of the study program master in “Mechatronics” have jointly defined the **Hosting University** by the pattern of the semester (see **Fig.1**). The exception makes the first and fourth semester.
  - The students of TU Liberec and HS Zittau/ Görlitz will pass the first semester at the university, where they got their Bachelor’s degree. Euro and Third-country students with less than 210 CP passing the first semester at the TU Liberec and HS Zittau/ Görlitz. Euro and Third-country students with 210 CP can start at the second semester. They can choose the home university TU Liberec as well as HS Zittau/Görlitz
  - In the beginning of the third semester students have to choose one of the Home Universities, where they will do their **Diploma Thesis** in the fourth semester.
2. Thesis Work can be assigned and worked out at HS Zittau/ Görlitz or at TU Liberec.

#### 3.3.2 Diploma thesis

1. Diploma thesis are announced by
  - Partner Universities that appointed a Supervisors (Thesis leader).
  - Corporations and companies
  - Research institutions
2. Students have to pick one
3. If the thesis is from the industry, than it is necessary to find a supervisor with the State Final Examination Boards of Mechatronics.
4. Thesis Work will be assigned by dean at:
  - HS Zittau/ Görlitz in the end of the third semester
  - TU Liberec in the beginning of the third semester. The students have to begin working on their Thesis Work immediately.

### 3.4 Study and Examination guidelines

#### 3.4.1 Study guidelines

1. The study and examination guidelines in semester satisfy the local law, standards and rules of the Hosting University.
2. Courses, including course material, instruction, examination, and study counseling are English at both universities.
3. Lecturers and educational personal, time table, the form of examination in given semester will determine the Hosting University.
4. Thesis Work will be made up in accordance with the local rules and laws at chosen university.
5. Diploma Thesis is written and defended in English. In a special case it can be in German, the State Rigorous Examination must be in English [Details see 3.3.2 (3.)].

### 3.4.2 Examination guidelines

1. Modules and examination will be credited by “**European Credit Transfer System ECTS**”. Semester project, Semester work, Lab protocol and papers have to be determined in examination and study rules.
2. The master study program “Mechatronics” is valued during two years at a minimum of **120 ECTS**. The sum have to be valued :
  - minimum of 30ECTS at the TU Liberec FM in the first preparatory semester
  - minimum of 30ECTS at the TU Liberec FM in the second semester
  - minimum of 30ECTS at the HS Zittau/Görlitz F-EI in the third semester
  - 30ECTS by making up of their Thesis Work at one of the universities TU Liberec or HS Zittau/Görlitz.
    - Students registered in the fourth at HS Zittau/Görlitz have their Diploma Thesis work valued at 30 ECTS. They are only working on their Diploma Thesis in the Industry (see Table 4).
    - Students registered in the fourth semester at TU Liberec have their Diploma Thesis work valued at 12 ECTS and Diploma Colloquium at 3 ECTS. Further they have to take 3 obligatory elective subjects valued altogether at 15 ECTS that are shown in the Table 4. So during the fourth semester they will have 30 ECTS too.
3. This program has to be completed by the “State Final Examination of Mechatronics” involving the “**Defense of a thesis**” and “**State Rigorous Examination**” of four thematic domain appointed by the “State Final Examination Board of Mechatronics” as the “Topic of Master degree state examination Mechatronics”.
4. Students, who complete successfully the Master in Mechatronics program, will receive Double Master’s Degree.

## 3.5 Admission and Application procedure

### 3.5.1 Admission requirements

1. The selection process will be carried out by **Admission Board of Mechatronics**. An Admission requires:
  - An appropriate Bachelor’s degree at HS Zittau/Görlitz, at TU Liberec (home universities) or a Diploma (D), Diploma (F), First Degree (E) valued in 180 ECTS (min. 6 Semesters) with a certificate of successful completion.
  - Passing the requirements entrance condition of
    - Consecutive two-level study master program mechatronics at HS Zittau/Görlitz
    - Consecutive two-level study program *Electrical Engineering and Informatics* in the academic discipline “Mechatronics” at the TU Liberec.
  - Passing the entrance exam by the examining board of Master in Mechatronics at TU Liberec.
2. Students enrolled by their home university have to register by the host university according the pattern of semesters.
3. The bachelor’s degrees at HS Zittau/Görlitz valued in 210 ECTS are recognized as the preparatory first semester. It enables students to enter direct the second semester of Master in Mechatronics.

### 3.5.2 Application procedure

1. The Home and European students follow the local routines for enrolment at TU Liberec and HS Zittau/Görlitz.
2. The Third-land students have the deadline **on April the 28th.**

### 3.5.3 Required documents

The follow documents requested must be in English.

1. Application Form
2. Official transcript of the university records and the official Bachelor degree certificate. All documents must be officially true attested copies. All translations must be officially certified and accompanied by the copy of the original.
3. Letter of motivation
4. Language test report
5. A Curriculum Vitae in English.
6. A copy of the passport
7. Name, address and kind of relation to nearest relative.

European students and Third-country students send their Application to:

Technická univerzita v Liberci  
Děkanát fakulty mechatroniky, informatiky a mezioborových studií  
Studentská 2  
CZ – 461 17 Liberec 1  
Master „Mechatronics“  
E-mail: [dagmar.militka@tul.cz](mailto:dagmar.militka@tul.cz) (Secretary of Faculty)

or

Hochschule Zittau/Görlitz (FH)  
Akademische Verwaltung  
D-02763 Zittau  
Theodor-Körner-Allee 16  
Master „Mechatronics“  
E-Mail: [s.kuehne@hs-zigr.de](mailto:s.kuehne@hs-zigr.de)  
German

## 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

1. Students who complete this program successfully will receive **Certificate of successful completion** from the Home University
  - TU Liberec see attachment 1
  - University Zittau/Görlitz see attachment 2
2. The Home University awards the Double Degrees with Diploma Supplements.
  - Diploma degree **“Master of Engineering”** from the consecutive two-level study program **“Master in Mechatronics”** at the HS Zittau/Görlitz attachment 3 and
  - Diploma degree **“Inženýr”**, (Master of Engineering) briefly **“Ing.”** from the consecutive master study program **Electrical Engineering and Informatics** in the academic discipline/field **“Mechatronics”** at the TU Liberec attachment 4.
3. The universities TU Liberec and HS Zittau/Görlitz make out the Diploma-Supplement attachment 5.

### 3.6.4 Enter to the PhD study

1. Admission to the doctoral study in German for graduates from HS Zittau/Görlitz is given by promotion rules at the University Faculties.
2. Graduates at the TU Liberec enter the doctoral courses without the admission examination, when the graduate has an appropriate thesis topics and a professor gave him a good recommendation.

### 3.7 Fees

1. The universities TU Liberec and HS Zittau/Görlitz will charge tuition fees according to their national legislation. In this time there are any.
2. A student has to pay the administrative fees as required by local law at the Hosting University.
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 Socrates/Erasmus Program according its structure and rules.
2. The both Partner University will endeavor the finding the financial funding.

### 3.9 Finding accommodation

1. The both Partner University operate their own halls of residence.
2. The cost of such accommodation varies depending on its quality from 50€–90€.
3. There is a possibility to find their accommodation within the private sector.

### 3.10 Execution of the study programs

1. The students, registered in this study program 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. The State Final Examination Board of Master in Mechatronics, matriculation department and other institutions of the Hosting University are responsible for the execution of the jointly developed regulations for this study program.
4. 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.
5. The Hosting University is responsible for ensuring local laws about safety rooms, laboratory equipment etc.

## **3.11 Administrative Formalities**

### **3.11.1 Czech Administrative Formalities**

Generally

1. Students who are EU and EEA Member States citizen with respect to the health insurance and visa have the same rights as in their home country.
2. Before departure, citizens from non-EU countries coming to the Czech Republic for the purpose of study need can contact the Czech embassy to consulate for information on the health insurance and visas

### **3.11.2 German Administrative Formalities**

Generally

1. Students have to register with the local authority (Einwohnermeldung) when they arrive in Germany.
2. The student must prove if his health insurance (from own country) is recognized in Germany or he have to have German health insurance.
3. Apart from the visa, which is not necessary for EU citizens, every student from abroad needs a proof of solvency, certifying the grant of scholarship or an affidavit of support.

## **Attachments**



**Technical University of Liberec**

# DIPLOMA

No. 00001

**Josef Novák**

(First name and Surname)

2. July 1971 – Czech republic  
(Date and Place of Birth)

completed university education in master study programme

**E l e c t r o t e c h n i c s   a n d   i n f o r m a t i c s**

with speciality in **M e c h a t r o n i c s**

Study direction: Mechatronics

at the **Faculty of Mechatronics**

In compliance with the article 46, paragraph 4 on Higher Education Act No. 111/1998 Collection  
and on modifications and amendments of further acts he is awarded

the degree of **Inženýr**, abbreviated as **Ing.** used in front of the name.

code: M 2301

code (KKOV): 2303T002

In Liberec 17. June 2004

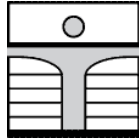
Rector

Dean

**Attachement 2** Zeugnis Deutsch  
Zeugnis Englisch

Zittau

FREISTAAT SACHSEN



**HOCHSCHULE ZITTAU/GÖRLITZ**  
(FH) - University of Applied Sciences

FACHBEREICH ELEKTRO- UND  
INFORMATIONSTECHNIK

# ZEUGNIS

über die Masterprüfung

Herr/Frau «vorname» «name»

geboren am ..... in .....

hat im Studiengang

**MECHATRONIK**

(Dual-Post-Degree-Programm)

studiert

und die Masterprüfung bestanden.

Gesamturteil:

.....

(Durchschnittsnote: .....)

Ergebnisse der Masterprüfung

## 1. Masterarbeit

Thema der Masterarbeit:

Gesamtnote der Masterarbeit: «diplNote»

## 2. Modulprüfungen

s. Studienablaufplan(Lehrfach)

(Note)

.....

.....

.....

.....

.....

.....

.....

.....

3. Module, deren Bewertung nicht in das Gesamturteil eingegangen sind  
(u. U. fakultativ gewählte Wahlpflichtfächer auf Antrag der Studenten)

.....

.....

.....

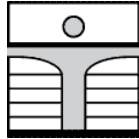
.....

**Attachement 3**

Masterurkunde Deutsch  
Masterurkunde Englisch

Zittau

FREISTAAT SACHSEN



**HOCHSCHULE ZITTAU/GÖRLITZ**  
(FH) - University of Applied Sciences

# U R K U N D E

Herr/Frau «vorname» «name»

geboren am «gebdatum» in .....

hat die Masterprüfung im Studiengang

**Mechatronik**

**(Dual-Post-Degree-Programm)**

erfolgreich abgelegt.

Die Hochschule Zittau/Görlitz (FH)

- University of Applied Sciences -

verleiht durch diese Urkunde

den Hochschulgrad

**Master of Engineering**

- MEng -

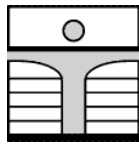
Zittau/Görlitz, .....

Siegel

N.N.  
Rektor

N.N.  
Vorsitzender des Prüfungsausschusses  
Fachbereich Elektro- und Informationstechnik

FREE STATE OF SAXONY



**HOCHSCHULE ZITTAU/GÖRLITZ**  
(FH) - University of Applied Sciences

It is herewith certified that

**Ms/Mr «vorname» «name»**

born on ..... in .....

having successfully completed the relevant Master course  
has been admitted to the degree of Master following a course of study in  
the field of

**Mechatronics**

**(Dual-Post-Degree-Programm)**

and that the

Zittau/Görlitz University of Applied Sciences (FH)

hereby awards the degree of

**Master in Engineering**

- MEng -.

Zittau/Görlitz, .....

University Seal

N.N.  
Rector

N.N.  
Chair of the Board of Examiners  
Department of Electrical Engineering  
and Information Technology

# Attachement 4

## Muster

ČESKÁ REPUBLIKA

Technická univerzita v Liberci

## DIPLOMA SUPPLEMENT / DODATEK K DIPLOMU

Diploma No / Diplom č.: TUL \*

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 organizacemi UNESCO/CEPES. Účelem dodatku je poskytnout odpovídající množství nezávislých údajů pro zlepšení mezinárodní „průhlednosti“ a spravedlivosti akademického a profesního uznávání kvalifikací (diplomů, titulů, osvědčení atd.). Dodatek je určen pro popis podstaty, obsahu, úrovně a postavení studií, která byla uskutečněna a úspěšně dokončena držitelem kvalifikace, ke které je tento dodatek připojen. Dodatek nemá obsahovat žádné ocenění, prohlášení o rovnocennosti nebo doporučení k uznání. Je třeba, aby všech osm částí dodatku bylo vyplněno. Tam, kde informace poskytnuty nebudou, mělo by být uvedeno vysvětlení proč.

### 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 Computer Science / Elektrotechnika a informatika, Mechatronics / Mechatronika*
- 2.3 Name and type of awarding institution / Název a postavení udělující instituce: *Technická univerzita v Liberci, Public Higher Education Institution / Veřejná 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 / Veřejná vysoká škola*
- 2.5 Language(s) of instruction / examination / Jazyk(y) studia / zkoušek: \_\_\_\_\_

### 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: 10, credits / kreditů: 300*
- 3.3 Access requirements / Požadavky na přístup ke studiu: *Secondary school leaving certificate / Maturitní vysvědčení*

### 4. Information on the contents and results gained / Informace o obsahu a dosažených výsledcích

- 4.1 Form of study / Forma studia: *Full-time / Prezenční*

- 4.2 Programme requirements / Požadavky v rámci programu:

The study course "Mechatronics" comprises of a broad scope of courses. It prepares students to become experts with sound knowledge in the fields of informatics, automation, diagnostics, design of control systems for machines with optimal combinations of mechanical, electronic, pneumatic and hydraulic components. Particular emphasis is put on the student's ability to propose design concepts.

Studijní obor "Mechatronika" je určen pro přípravu odborníků se znalostmi v oblasti informatiky, automatizace, diagnostiky, měřících a řídicích procesů a konstrukce elektronického řízení strojů s optimálním využitím mechanických, elektrických, hydraulických a pneumatických prvků a uzlů. Zvláštní důraz je kladen na výchovu pracovníků navrhujících koncepce řešení.

- 4.3 Programme details and the individual grades/credits obtained / Podrobné údaje o programu a jednotlivých dosažených hodnoceních/kreditach:

| Code<br>Kód předmětu | Subject / Název předmětu                                        | Date<br>Datum | Exam mark<br>Známka | Credits<br>Kredity | Language |
|----------------------|-----------------------------------------------------------------|---------------|---------------------|--------------------|----------|
| KTM/TMB*M            | Technical Materials / Technické materiály B                     | 10.11.1999    | 3                   | 5                  | Czech    |
| KFL/PKM*M            | Principles of Critical Thinking / Principy kritického myšlení   | 13.01.2000    | R                   | 3                  | Czech    |
| KRT/UDI              | Introduction to Engineering / Úvod do inženýrství               | 17.01.2000    | 2                   | 3                  | Czech    |
| KMD/ZDM              | Elements of Discrete Mathematics / Základy diskretní matematiky | 28.01.2000    | 2                   | 5                  | Czech    |
| KSI/CIP              | Digital Computers / Číslicové počítače                          | 01.02.2000    | 1                   | 5                  | Czech    |

### 8. Information on the national higher educational system / Informace o národním vysokoškolském systému

#### Higher Education System in the Czech Republic

Higher education institutions form the highest level of Czech education. They offer accredited study programmes at three levels – bachelor, master, and doctoral, as well as lifelong learning. Higher education institutions are either university-type or non university-type.

University-type higher education institutions may offer all types of study programmes (bachelor, master and doctoral) and carry out associated scholarly, research, developmental, artistic or other creative activities. Non university-type higher education institutions offer mainly bachelor study programmes, but may also provide master study programmes and carry out associated scholarly, research, developmental, artistic or other private higher education institutions. The public and private higher education institutions come under the responsibility of the Ministry of Education, Youth and Sports, while state institutions (military universities and the police academy) are under the responsibility of the Ministry of Defence and the Ministry of the Interior. The list is available at <http://www.mmt.cz/files/htm/Viewwseer.htm> or <http://www.csvs.cz>.

Higher education is realised within the framework of accredited study programmes in accordance with their curricula and given form of studies. The form of study can be full-time, part-time (distance) or a combination of both. Access to a bachelor study programme is conditional on completing a full secondary general or vocational education with a "maturita" examination and a "maturita" leaving certificate (maturitní vysvědčení). In the field of arts, access to study may be conditional on completing a post-secondary education offered by conservatoires. Access to master studies is conditional on graduating from a bachelor study programme, while access to a doctoral study programme is conditional on graduating from a master study programme, in the field of arts is also conditional on awarding of an academic title. A higher education institution may rule other conditions for access to study programmes.

#### Higher Education Qualifications

The qualification structure recognises bachelor, master and doctoral levels.

A bachelor study programme (bakalářský studijní program) aims at qualifying students to enter a profession or a master study programme. It takes from 3 to 4 years (180 – 240 ECTS credits). Graduates receive the academic degree bakalář (BcA.) in the field of arts, and bakalář (Bc.) in other fields. The study programme must be completed in due form with a final state examination, which usually includes the presentation and defence of a bachelor thesis. Titles are written before the name.

A master study programme (magisterský studijní program) follows a bachelor study programme. The length is 1 – 3 years (60 – 180 ECTS credits). In selected fields, where the nature of the study programme so requires, a master study programme need not follow on from a bachelor programme. In this case, the programme lasts 4 – 6 years (240 – 360 ECTS credits). Admission to these study programmes is conditional on passing the "maturita" examination (see access to bachelor studies).

Graduates in a master study programme have to take a final state examination and publicly present and defend a master thesis. Studies in the fields of medicine, veterinary medicine and hygiene are completed by passing a rigorous state examination including the presentation and defence of a rigorous thesis. The studies in a master programme lead to the academic degrees:

- magistr (Mgr.) – Master in humanities, sciences, law, teacher education, pharmacy and theology;
- magistr umění (MgA.) – Master of arts in the field of art;
- inženýr (Ing.) – Engineer in the field of economics, technical sciences and technologies, agriculture, forestry and in military fields of study;
- inženýr architekt (Ing.arch.) – Engineer Architect in the field of architecture;
- doktor medicíny (MUDr.) – Doctor of Medicine in the field of medicine;
- zubní lékař (MDDr.) – Dentist in the field of dentistry;
- doktor veterinární medicíny (MVDr.) – Doctor of Veterinary Medicine in the field of veterinary medicine and hygiene.

Courses in human medicine and veterinary medicine last 6 years. They are run by the university medical faculties and faculties of veterinary medicine.

- Holders of the academic degree "magistr" can pass a rigorous state examination in the same field and present and defend a rigorous thesis. If completed successfully, the following academic degrees are awarded:
- "doktor práv" (JUDr.) in the field of law;
  - "doktor filosofie" (PhDr.) in the field of humanities, teacher education and social sciences;
  - "doktor přírodních věd" (RNDr.) in the field of natural sciences;
  - "doktor farmacie" (PharmDr.) in the field of pharmacy;
  - "licenciát teologie" (ThLic.) in the field of Catholic theology;
  - "licenciát teologie" (ThLic.) or "doktor teologie" (ThDr.) in the field of theology except Catholic theology.

All above mentioned academic titles are at master level and are written before the name.

The standard length of a doctoral study programme (doktorský studijní program) is either 3 or 4 years. Doctoral studies are completed by the state doctoral examination and the public presentation and defence of a doctoral thesis (dissertation) based on original results, which must be published. Graduates of a doctoral study programme are awarded the academic degree of "doktor" (Ph.D.) or "doktor teologie" (Th.D.) in the field of theology. These academic titles are written after the name.

#### Academic year

The academic year starts on September 1 and ends on August 31 of the following year. It comprises a winter semester and a summer semester. The organisation of academic years is regulated by the statute of the given Higher Education Institution.

#### Credit system

A credit system (ECTS or a comparable system) is used at most of the higher education institutions.

#### Vysokoškolský vzdělávací systém v České republice

Vysoké školy představují nejvyšší úroveň vzdělávacího systému v České republice. Nabízejí akreditované studijní programy tří typů – bakalářské, magisterské a doktorské, a také celoživotní vzdělávání. Vysoké školy jsou univerzitního a neuniverzitního typu.

Vysoká škola univerzitní uskutečňuje všechny typy studijních programů a v souvislosti s tím vědeckou a výzkumnou, vývojovou, umleckou nebo další tvůrčí činnost. Vysoká škola neuniverzitní uskutečňuje převážně bakalářské, může též uskutečňovat magisterské studijní programy a v souvislosti s tím výzkumnou, vývojovou, umleckou nebo další tvůrčí činnost. Vysoká škola neuniverzitní se nečlení na fakulty.

Vysoké školy jsou veřejné, státní a soukromé. Veřejné a soukromé vysoké školy spadají do působnosti Ministerstva školství mládeže a tělovýchovy, státní instituce (vojenské vysoké školy a policejní akademie) spadají do působnosti Ministerstva obrany a Ministerstva vnitra. Seznamy vysokých škol jsou k dispozici na: <http://www.mmt.cz/files/htm/Viewwseer.htm> a na [www.csvs.cz](http://www.csvs.cz).

Vysokoškolské vzdělání se získává studiem v rámci akreditovaného studijního programu podle studijního plánu stanovenou formou studia. Forma studia může být prezenční, distanční nebo jejich kombinace.

Podmínkou přijetí ke studiu v bakalářském a magisterském studijním programu je dosažení úplného středního nebo úplného středního odborného vzdělání. Ke studiu v oblasti umění mohou být přijati též uchazeči s výjimečným odborným vzděláním poskytnutým v konzervatořích. Podmínkou přijetí ke studiu v magisterském studijním programu, který navazuje na bakalářský studijní program, je rovněž řádné ukončení studia v bakalářském studijním programu. Podmínkou přijetí ke studiu v doktorském studijním programu je řádné ukončení studia v magisterském studijním programu a v oblasti umění též získání akademického titulu. Vysoká škola nebo fakulta může stanovit další podmínky přijetí ke studiu týkající se určitých směrů, schopností nebo nadání apod.

#### Vysokoškolské kvalifikace

Kvalifikační struktura rozlišuje tři typy studijních programů – bakalářský studijní program, magisterský studijní program a doktorský studijní program.

Bakalářský studijní program je zaměřen na přípravu k výkonu povolání nebo ke studiu magisterského studijního programu. Standardní doba studia je 3 až 4 roky (180 – 240 ECTS kreditů). Absolventi získají akademický titul „bakalář“ (Bc.), v oblasti umění „bakalář umění“ (BcA.). Studium se řádně ukončuje státní závěrečnou zkouškou, jejíž součástí je správní obhajoba bakalářské práce. Tituly se uvádějí před jménem.

Magisterský studijní program navazuje na bakalářský studijní program. Standardní doba studia je 1 až 3 roky (60 – 180 ECTS kreditů). V případech, kdy to vyžaduje charakter studijního programu, může být udělena akreditace magisterského studijního programu, který nenavazuje na bakalářský studijní program. Standardní doba studia je potom 4 až 6 let (240 – 360 ECTS kreditů). Studium se řádně ukončuje státní závěrečnou zkouškou, jejíž součástí je obhajoba diplomové práce. V oblasti lékařství, zubního lékařství a veterinárního lékařství a hygieny se studium řádně ukončuje státní rigorózní zkouškou. Absolventům se uděluje titul akademické tituly:

- v oblasti ekonomie, technických věd a technologií, zemědělství, lesnictví a vojenské „inženýr“ (ve zkratce „Ing.“),
- v oblasti architektury „inženýr architekt“ (ve zkratce „Ing.arch.“),
- v oblasti lékařství „doktor medicíny“ (ve zkratce „MUDr.“),
- v oblasti zubního lékařství „zubní lékař“ (ve zkratce „MDDr.“),
- v oblasti veterinárního lékařství a hygieny „doktor veterinární medicíny“ (ve zkratce „MVDr.“),
- v oblasti umění „magistr umění“ (ve zkratce „MgA.“),
- v ostatních oblastech „magistr“ (ve zkratce „Mgr.“).

Absolventi magisterských studijních programů, kteří získali akademický titul „magistr“, mohou vykonávat v této oblasti studia státní rigorózní zkoušku, jejíž součástí je obhajoba rigorózní práce. Po jejím vykonání se uděluje titul akademické tituly:

- v oblasti práva „doktor práv“ (ve zkratce „JUDr.“),
- v oblasti humanitních, pedagogických a společenských věd „doktor filosofie“ (ve zkratce „PhDr.“),
- v oblasti přírodních věd „doktor přírodních věd“ (ve zkratce „RNDr.“),
- v oblasti farmacie „doktor farmacie“ (ve zkratce „PharmDr.“),
- v oblasti teologie „licenciát teologie“ (ve zkratce „ThLic.“) nebo „doktor teologie“ (ve zkratce „ThDr.“); pro oblast katolické teologie „licenciát teologie“.

Všechny dosud zmíněné tituly jsou magisterské a uvádějí se před jménem.

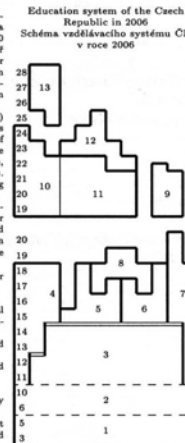
Standardní doba doktorského studijního programu je tři nebo čtyři roky. Doktorské studium se řádně ukončuje státní doktorskou zkouškou a obhajobou disertační práce. Absolventům doktorského studijního programu se přisuzuje akademický titul „doktor“ (ve zkratce „Ph.D.“), „doktor teologie“ (ve zkratce „Th.D.“) v oblasti teologie. Zkratky titulu titulu se uvádějí za jménem.

#### Akademický rok

Akademický rok začíná obvykle 1. září a končí 31. srpna následujícího roku. Sestává se z zimního a letního semestru. Organizace akademického roku je určena statutem dané vysoké školy.

#### Kreditní systém

Kreditní systém (ECTS nebo srovnatelný systém) je užíván většinou vysokých škol.



# Study Program Guide „Master in Mechatronics”

**DIPLOMA SUPPLEMENT** **Muster** Name: Diploma No: TUL \*

| Code<br>Kód předmětu | Subject / Název předmětu                                                                 | Date<br>Datum | Exam mark<br>Známka | Credits<br>Kredity | Language |
|----------------------|------------------------------------------------------------------------------------------|---------------|---------------------|--------------------|----------|
| KMD/MA1*M            | Mathematics 1 / Matematika 1                                                             | 17.02.2000    | 3                   | 6                  | Czech    |
| KFY/FYL*M            | Laboratory Training in Physics / Fyzikální laboratoře                                    | 26.05.2000    | R                   | 5                  | Czech    |
| KST/TD1*M            | Bases of Technical Documentation I / Tvorba technické dokumentace I                      | 27.05.2000    | 2                   | 3                  | Czech    |
| KSP/ST1*M            | Engineering technologies / Strojírenská technologie                                      | 30.05.2000    | 3                   | 5                  | Czech    |
| KMD/MA2*M            | Mathematics 2 / Matematika 2                                                             | 13.06.2000    | 3                   | 6                  | Czech    |
| KSI/PRG              | Programming / Programování                                                               | 15.06.2000    | 3                   | 5                  | Czech    |
| KTV/TV2*M            | Physical education 2 / Tělesná výchova pro mechatroniku 2                                | 19.08.2000    | R                   | 2                  | Czech    |
| KFY/FY1*M            | Physics 1 / Fyzika 1                                                                     | 17.09.2001    | 2                   | 6                  | Czech    |
| KCJ/A1*M             | Language - English 1 / Jazyk - Angličtina 1                                              | 16.10.2001    | R                   | 3                  | Czech    |
| KST/TD2*M            | Bases of Technical Documentation II / Tvorba technické dokumentace II                    | 09.01.2002    | R                   | 3                  | Czech    |
| KMO/ME2              | Mechanics II / Mechanika II                                                              | 12.01.2002    | 3                   | 5                  | Czech    |
| KTV/TVYX             | Physical education / Tělesná výchova                                                     | 15.01.2002    | R                   | 2                  | Czech    |
| KRT/ZSR              | Basics of Control Engineering / Základy spojitého řízení                                 | 30.01.2002    | 3                   | 5                  | Czech    |
| KSI/ALGX             | Algorithms and Grammmatics / Algoritmy a gramatiky                                       | 07.02.2002    | 2                   | 4                  | Czech    |
| KEL/ELO              | Electrical Circuits / Elektrické obvody                                                  | 12.02.2002    | 2                   | 5                  | Czech    |
| KRT/ZLR              | Basics of Logic Control / Základy logického řízení                                       | 24.05.2002    | 2                   | 5                  | Czech    |
| KMO/ME1              | Mechanics I / Mechanika I                                                                | 30.05.2002    | 3                   | 6                  | Czech    |
| KSI/TPA1             | Application Programming / Tvorba počítačových aplikací                                   | 30.05.2002    | 3                   | 5                  | Czech    |
| KEL/TEE              | Theoretical Electrical Engineering / Teoretická elektrotechnika                          | 17.08.2002    | 3                   | 5                  | Czech    |
| KAM/MT1              | Measuring Technique I / Měřicí technika I                                                | 15.01.2003    | R                   | 5                  | Czech    |
| KAP/MA5*M            | Mathematics V / Matematika V                                                             | 31.01.2003    | 1                   | 5                  | Czech    |
| KMO/MTE              | Fluid Mechanics / Mechanika tekutin                                                      | 12.02.2003    | 2                   | 3                  | Czech    |
| KRT/MS1              | Modelling and Simulation of Systems I / Modelování a simulace systémů I                  | 25.03.2003    | 3                   | 5                  | Czech    |
| KST/KP*M             | Design Methods and Processes / Konstrukční metody a postupy                              | 20.05.2003    | R                   | 5                  | Czech    |
| KES/EZA*M            | Design of Electronic Devices / Elektronická zařízení                                     | 21.05.2003    | R                   | 4                  | Czech    |
| KMD/MA3*M            | Mathematics 3 / Matematika 3                                                             | 05.06.2003    | 3                   | 5                  | Czech    |
| KSI/PJ1              | Programming Languages and Operation Systems I / Programovací jazyky a operační systémy I | 06.06.2003    | 2                   | 6                  | Czech    |
| KAM/MT2              | Measuring Technique II / Měřicí technika II                                              | 11.06.2003    | 2                   | 4                  | Czech    |
| KMO/M6B              | Mathematics Vlb / Matematika Vlb                                                         | 19.06.2003    | 2                   | 5                  | Czech    |
| KFY/FY2X             | Physics 2 / Fyzika 2                                                                     | 16.01.2004    | 3                   | 5                  | Czech    |
| KSI/PPRX             | Programming Tools / Prostředky pro programování                                          | 22.01.2004    | 3                   | 4                  | Czech    |
| KES/AELX             | Analog Electronics / Analogová elektronika                                               | 12.02.2004    | 3                   | 5                  | Czech    |
| KFY/FY3X             | Physics 3 / Fyzika 3                                                                     | 18.05.2004    | 3                   | 5                  | Czech    |
| KES/CIEX             | Digital Electronics / Číslicová elektronika                                              | 14.06.2004    | 3                   | 5                  | Czech    |
| KMD/MA4X             | Mathematics 4 / Matematika 4                                                             | 17.06.2004    | 2                   | 6                  | Czech    |
| KMO/PPEX             | Elasticity and Strength / Pevnost a pružnost                                             | 02.09.2004    | 2                   | 5                  | Czech    |
| KCJ/A2*M             | Language - English 2 / Jazyk - Angličtina 2                                              | 10.12.2004    | 2                   | 2                  | Czech    |
| KSI/JAVX             | Java - Technical Applications / Java-technické aplikace                                  | 11.01.2005    | 3                   | 5                  | Czech    |
| KPE/ERI*M            | Economy and management of enterprises / Ekonomika a řízení podniku                       | 12.01.2005    | 3                   | 4                  | Czech    |
| KVS/HPMX             | Hydraulic and pneumatic mechanisms / Hydraulické a pneumatické mechanismy                | 14.01.2005    | 2                   | 6                  | Czech    |
| KSI/ZINX             | Information Processing / Zpracování informace                                            | 18.01.2005    | 2                   | 4                  | Czech    |
| KEL/EVCX             | Electrical Power Systems / Elektrické výkonové členy                                     | 25.01.2005    | 2                   | 4                  | Czech    |
| KSI/PMPX             | Computers and Microcomputers / Počítače a mikropočítače                                  | 31.01.2005    | 2                   | 4                  | Czech    |
| KAI/PSIX             | Computer Networks / Počítačové sítě                                                      | 26.05.2005    | 2                   | 4                  | Czech    |
| KAM/CMSX             | Digital Measurement Systems / Číslicové měřicí systémy                                   | 26.05.2005    | 3                   | 4                  | Czech    |
| KRT/SVMX             | Drives and Servomechanisms / Pohony a servomechanismy                                    | 02.06.2005    | 2                   | 4                  | Czech    |
| DFM/PRO1X            | Project 1 / Projekt 1                                                                    | 09.06.2005    | R                   | 3                  | Czech    |
| DFM/PRO2X            | Project 2 / Projekt 2                                                                    | 09.06.2005    | 2                   | 5                  | Czech    |
| KEL/EPVX             | Electrical Converters of Physical Quantities / Elektrické převodníky fyzikálních veličin | 13.06.2005    | 2                   | 5                  | Czech    |
| KSK/ZR*M             | Basic of Robotics / Základy robotiky                                                     | 23.06.2005    | 2                   | 4                  | Czech    |
| KES/SIGX             | Signal Processing / Zpracování, přenos a identifikace signálů                            | 27.06.2005    | 2                   | 4                  | Czech    |
| KSI/TIAX             | Internet Programming / Tvorba internetových aplikací                                     | 11.01.2006    | 3                   | 6                  | Czech    |
| KEL/RACX             | Action Elements Control / Řízení akčních členů                                           | 12.01.2006    | 3                   | 6                  | Czech    |
| KSI/RPSX             | Control Computer Systems / Řídicí počítačové systémy                                     | 19.01.2006    | 2                   | 6                  | Czech    |
| KVS/AVSX             | Automatic Control of Production Machines / Automatické řízení výrobních strojů           | 24.01.2006    | 3                   | 6                  | Czech    |
| KTS/SMUX             | Mechanisms and Machinery Systems Design / Stavba mechanismů a uzlů strojů                | 01.02.2006    | 3                   | 6                  | Czech    |
| KEL/DSMX             | Diploma Seminar / Diplomový seminář                                                      | 24.04.2006    | 3                   | 5                  | Czech    |
| KSD/RSV              | Control systems of Vehicles / Řídicí systémy vozidel                                     | 27.04.2006    | 1                   | 5                  | Czech    |
| KTS/PPKX             | Computed Aided Machine Design / Počítačem podporovaná konstrukce strojů                  | 02.05.2006    | 3                   | 5                  | Czech    |
| KSI/IROX             | Intelligent Robotics / Inteligentní roboty                                               | 09.05.2006    | 2                   | 5                  | Czech    |

**DIPLOMA SUPPLEMENT** Name: ~~Karel DUB~~ Diploma No: TUL \* 001683

| Code<br>Kód předmětu                                                                       | Subject / Název předmětu          | Date<br>Datum         | Exam mark<br>Známka         | Credits<br>Kredity | Language |
|--------------------------------------------------------------------------------------------|-----------------------------------|-----------------------|-----------------------------|--------------------|----------|
| DFM/DPRX                                                                                   | Diploma Project / Diplomová práce | 19.05.2006            | R                           | 10                 | Czech    |
| <b>Final State Examination / Státní závěrečná zkouška</b>                                  |                                   | <b>Date<br/>Datum</b> | <b>Exam mark<br/>Známka</b> | <b>Language</b>    |          |
| Expert discourse / Odborná rozprava                                                        |                                   | 13.06.2006            | 3                           | Czech              |          |
| <b>Thesis / Diplomová práce</b>                                                            |                                   | <b>Date<br/>Datum</b> | <b>Exam mark<br/>Známka</b> | <b>Language</b>    |          |
| Voice control of home electric appliance / Hlasové ovládání elektrospotřebičů v domácnosti |                                   | 13.06.2006            | 2                           | Czech              |          |

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

| ECTS<br>grade/stupeň | Exam Mark<br>Známka | Grade<br>známka slovně |
|----------------------|---------------------|------------------------|
| A                    | 1                   | výborně                |
| B,C                  | 2                   | velmi dobře            |
| D,E                  | 3                   | dobře                  |
| Fx,F                 | 4                   | nevyhověl              |

R – Satisfactory completion of course, no grade / Předmět splněn  
P – Exam was passed in previous study / Uznáný předmět  
B – Bachelor studies / Bakalářské studium,  
M – Master studies / Magisterské studium,  
D – Doctoral studies / Doktorské studium,  
C – Lifelong studies / Celoživotní studium

4.5 Overall classification of the qualification / Celková klasifikace kvalifikace: *Passed / Absolvoval*

## 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 / Inženýr*

## 6. Additional information / Doplnkové informace

6.1 Additional information / Doplnkové informace:

*Credit system has been introduced during the studies / Kreditní systém byl zaveden v průběhu studia*

6.2 Further information sources / Další informační zdroje:

<http://www.vslib.cz>, <http://www.msmt.cz>, <http://www.uiv.cz>

## 7. Certification of supplement / Potvrzení dodatku

7.1 Date / Datum: 11.01.2007

7.2 Signature / Podpis: prof. Dr. Ing. Jiří Maryška, CSc.

prof. Ing. Vojtěch Konopa, CSc.

7.3 Capacity / Funkce: dean

děkan Fakulty mechatroniky a mezipodborových inženýrských studií

rektor / rektor

7.4 Official stamp or seal / Oficiální razítko nebo pečeť:

## Attachement 5

### Diploma Supplement

#### Anlage zum Diploma Supplement – Transcript of Records

##### Transcript of Records (Master-Mechatronic Dual-Post-Degree-Programm)

Prüfungsordnung Mechatronik vom .....

|    |       |                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  |       | Robotik                                                                                                                                                                                                                                                                                                                                                                                                      | Robotics                                                                                                                                                                                                                                                                                                                                                                                                               |
| 2  |       | Laborpraktikum II                                                                                                                                                                                                                                                                                                                                                                                            | Laboratory II                                                                                                                                                                                                                                                                                                                                                                                                          |
| 3  |       | Antriebe und Servomaschinen                                                                                                                                                                                                                                                                                                                                                                                  | Drives and Servomechanisms                                                                                                                                                                                                                                                                                                                                                                                             |
| 4  |       | Semester Projekt                                                                                                                                                                                                                                                                                                                                                                                             | Semestral project                                                                                                                                                                                                                                                                                                                                                                                                      |
| 5  |       | Maschinendynamik                                                                                                                                                                                                                                                                                                                                                                                             | Machine Dynamics                                                                                                                                                                                                                                                                                                                                                                                                       |
| 6  |       | Wahlpflichtfächer<br>Steuerungstechnik in der Mechatronik<br>Optische Systeme<br>Digitale Signalverarbeitung<br>Entwurf von elektrotechnischen Systemen<br>Elektronische Schaltungen und Komponenten<br>Elektrische Wandler für physikalische Größen                                                                                                                                                         | Obligatory elective Subjects<br>Control Systems in the Mechatronic<br>Photonics<br>Digital Signal Processing<br>Design of the electrotechnic systems<br>Electronics circuits and Components<br>Electrical Transducers of the Physical Quantities                                                                                                                                                                       |
| 7  | EI1-1 | Regelungstechnik II                                                                                                                                                                                                                                                                                                                                                                                          | Automatic Control II (advanced course)                                                                                                                                                                                                                                                                                                                                                                                 |
| 8  | EI2-1 | Digitale Signalverarbeitung                                                                                                                                                                                                                                                                                                                                                                                  | Digital Signal Processing                                                                                                                                                                                                                                                                                                                                                                                              |
| 9  | EI3-2 | Fuzzy-Control                                                                                                                                                                                                                                                                                                                                                                                                | Fuzzy Control                                                                                                                                                                                                                                                                                                                                                                                                          |
| 10 | EI4-2 | Digitale Kommunikationstechnik                                                                                                                                                                                                                                                                                                                                                                               | Digital Communication Technology                                                                                                                                                                                                                                                                                                                                                                                       |
| 11 | I1-2  | Image Processing                                                                                                                                                                                                                                                                                                                                                                                             | Image Processing                                                                                                                                                                                                                                                                                                                                                                                                       |
| 12 | I2-2  | Maschinennahe Programmierung<br>Schaltungsentwurf                                                                                                                                                                                                                                                                                                                                                            | Hardware-oriented Programming / Circuit Design                                                                                                                                                                                                                                                                                                                                                                         |
| 13 | MS1-1 | Modellgestützte Messverfahren/ nichtlineare<br>dynamische Systeme                                                                                                                                                                                                                                                                                                                                            | Model-based Measuring Methods/ Nonlinear Dynamic<br>Systems                                                                                                                                                                                                                                                                                                                                                            |
| 14 | MS2-2 | Künstliche Intelligenz/ Neuronale Netze                                                                                                                                                                                                                                                                                                                                                                      | Artificial Intelligence/Neural Networks                                                                                                                                                                                                                                                                                                                                                                                |
| 15 | AW1-2 | Unternehmensführung/Sprachen                                                                                                                                                                                                                                                                                                                                                                                 | Business Management/Languages                                                                                                                                                                                                                                                                                                                                                                                          |
| 16 | WP1-2 | <u>Wahlpflichtfach/Internationales Projekt</u><br>1. Magnetlagertechnik<br>2. Projekt/Projektmanagement<br>3. Fluidische Steuerungsmittel<br>4. SPS-Programmierung<br>5. Qualitätssicherung<br>6. Modellierung und Simulation<br>7. Lichtwellenleitertechnik<br>8. Wasser- und Windenergienutzung<br>9. Optische Sensoren<br>10. Photovoltaik<br>11. Prozessnahe Programmierung<br>/Programmentwicklung in C | <u>Optional Module /International Project</u><br>1. Magnetic Bearing Technology<br>2. Project/Project Management<br>3. Fluid Control Systems<br>4. Programmable Logic Controller (PLC)<br>5. Quality Control<br>6. Modelling and Simulation<br>7. Optical Transmission Systems<br>8. Use of Water and Wind Energy<br>9. Optical Sensors<br>10. Photovoltaics<br>11. Hardware Programming / Program Development in<br>C |
| 17 | WP2-3 | Abschlussmodul/Masterarbeit                                                                                                                                                                                                                                                                                                                                                                                  | Final Module/Master Thesis                                                                                                                                                                                                                                                                                                                                                                                             |