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## **TECHNISCHE UNIVERSITÄT ILMENAU**

### **Examination and Study Regulations - Special Provisions - for the program Research in Computer and Systems Engineering with the degree "Master of Science" - as amended by the First Amendment Statutes of 12 July 2022 -**

According to § 3 para. 1 in conjunction with § 38 para. 3 of the Thuringian Higher Education Act (ThürHG) of May 10, 2018 (GVBl. p. 149), amended by Article 7 of the Act of March 23, 2021 (GVBl. pp. 115, 118), the Technische Universität Ilmenau (hereinafter referred to as "University") enacts based on the Examination and Study Regulations - General Provisions - for degree programs "Bachelor", "Master" and "Diploma" of the University, published in the University Gazette No. 174 / 2019, as last amended by the third amendment statute, published in the University Gazette No. 216 / 2021, the following Examination and Study Regulations - Special Provisions - for the degree program Research in Computer and Systems Engineering with the degree "Master of Science", published in the University Gazette No. 225 / 2021, as amended by the First Amendment Statute, published in the University Gazette No. 233 / 2022.

The Council of the Department of Computer Science and Automation determined these Regulations on June 16, 2021. The Academic Committee commented favourably on them in a resolution dated July 13, 2021. The President approved them on February 25, 2022. The Council of the Department of Computer Science and Automation decided on the First Amendment to the Regulations on June 15, 2022. The Academic Committee commented favourably on it in a resolution dated July 12, 2022. The President approved it on July 12, 2022.

#### **Table of contents**

<b>A. General regulations</b>	<b>3</b>	
§ 1 Scope of the regulations	3	
<b>B. Studies and degree program</b>	<b>3</b>	
§ 2 Academic degree	3	
§ 3 Study requirements and prior knowledge	3	
§ 4 Objectives of the program, occupational field, profile type		3
§ 5 Standard length of study	4	
§ 6 Content, structure, and scope of the degree program; curriculum	4	
§ 7 Admission to program segments, admission to modules	5	
§ 8 Student advisory service	5	
§ 9 Language of instruction and examination	5	
<b>C. Examinations</b>	<b>5</b>	
§ 10 Admission to examinations	5	

§ 11 Type, form, and duration of examinations; deadlines	6	
§ 12 Second resit of examinations	6	
§ 13 Grade improvement and free attempt (Freiversuch)	6	
§ 14 Master's thesis	6	
§ 15 Determination of the overall grade	7	
<b>D. Final regulations</b>	<b>7</b>	
§ 16 Validity and termination of validity	7	
Annex Special admission requirements	9	
Annex Curriculum	11	
Annex Profile description	12	
Annex Regulations for practical training	17	
Annex Competence goals and regulatory field – elective course catalogues		20

## **A. General regulations**

### **§ 1 Scope of the regulations**

(1) The Examination and Study Regulations - Special Provisions - for the degree program Research in Computer and Systems Engineering with the degree "Master of Science" determine the contents, objectives, structure and organization of the degree program as well as details of the examination procedure in the mentioned degree program based on the Examination and Study Regulations - General Provisions - for degree programs with the degree "Bachelor", "Master" and "Diploma" of the University (PStO-AB), published in the University Gazette No. 174 / 2019 in the respective valid version. The annexes are part of these regulations.

(2) All references to persons and positions shall apply in the same way irrespective of gender.

## **B. Studies and degree program**

### **§ 2 Academic degree**

The university, on the proposal of the Department of Computer Science and Automation, awards students who successfully complete this Master's program the academic degree

"Master of Science"

as further professionally qualifying academic degree.

### **§ 3 Study requirements and prior knowledge**

(1) In addition to the general admission requirements for admission to a Master's degree program according to the Thuringian Higher Education Act, the special admission requirements specified in the Appendix Admission Requirements apply to this degree program.

(2) For modules offered in the elective area in a language of instruction and examination other than English as well as in the context of double degree programs (§ 9), it is recommended for the successful completion of the program to provide language skills of the language of instruction and examination on level B2 according to the Common European Framework of Reference for Languages (CEFR).

### **§ 4 Objectives of the program, occupational field, profile type**

- (1) The degree program aims at a research-oriented deepening of the technical and methodological competence in computer science already acquired in a university degree program and, if applicable, in practical professional practice. In addition, the ability to work in a team, social and communication skills are to be developed to a high degree during the studies. In the annex "Profile Description", the qualification objectives, content-related focal points of the degree program and the needs of the graduates in the industry are described in detail.
- (2) The degree program is consecutive with a profile of "research-oriented" according to § 4 Thüringer Studienakkreditierungsverordnung (ThürStAkkVO, ordinance on accreditation of degree programs).

## **§ 5 Standard length of study**

According to § 52 ThürHG, the standard length of study is four semesters. The regular start of the degree program is in the winter semester. However, the studies may be started in any semester.

## **§ 6 Content, structure, and scope of the degree program; curriculum**

- (1) The curriculum (Annex) outlines the content and structure of the degree program in such a way that the degree program can be completed within the standard length of study according to § 5, including all final examinations and, if applicable, the practical training and the Master's thesis (§ 14).
- (2) The program covers a total of 120 credit points (LP/ECTS).
- (3) Requirements of the module "Practical Vocational Training" as well as the crediting of practical vocational activities are defined in the annex "Regulations on practical vocational training".
- (4) In addition to the subject-specific modules, students are also recommended to attend the optional classes offered by the university exceeding the curriculum's requirements.
- (5) Self-study is essential for gaining specialized knowledge and for the deepening and broadening of the subjects' contents presented in the lectures and classes.
- (6) Students intending to obtain the academic degree in a double degree program based on a cooperation agreement with a partner university shall, unlike the curriculum described in the annex, complete classes at the partner university according to the provisions of the respective cooperation agreement and its supplements.
- (7) According to § 3 para. 7 PStO-AB, the corresponding regulations are defined in the annex "Competence goals and regulatory areas referring to elective course catalogue".
- (8) Should students intend to complete their studies during a longer stay abroad ('semester abroad'), it is recommended to do so in the third or fourth semester. An individual

study agreement must be concluded for this purpose. For the recognition of the academic achievements and examinations abroad, § 26 PStO-AB applies.

(9) Students are encouraged to participate in the self-governing bodies of the university, including the student body.

### **§ 7 Admission to program segments, admission to modules**

There are no special professional (qualitative and quantitative) requirements for admission to program segments and modules.

### **§ 8 Student advisory service**

The Department of Computer Science and Automation appoints a study advisor. He/she and the Office of Education / Examination Office of the Department of Computer Science and Automation provide individual study counselling on general questions concerning study organization and legal aspects of examinations.

### **§ 9 Language of instruction and examination**

(1) English is the language of instruction and examination in the degree program Research in Computer and Systems Engineering. Individual modules in the elective program may also be offered in German. The language of the examination corresponds to the language of the class. The person responsible for the module determines the language of instruction and examination for the respective module in the module description according to sentences 1 and 2 as well as § 3 para. 9 sentences 1 to 3 PStO-AB.

(2) For students aiming for the academic degree in a double degree program based on a cooperation agreement with a partner university (§ 9 PStO-AB), the classes and examinations at the partner university take place in the language of instruction and examination customary there. The provisions of the cooperation agreement and its supplementary agreements apply to the Master's thesis.

## **C. Examinations**

### **§ 10 Admission to examinations**

There are no program-specific requirements for admission to examinations.

## **§ 11 Type, form, and duration of examinations; deadlines**

(1) The type of examination to be taken (§ 10 para. 1 PStO-AB) is specified in the curriculum (annex). The form and duration of the examination (graded or non-graded examinations) are determined by the module officer in the module description (§ 11 PStO-AB).

(2) Alternative academic achievements (examinations), which must be provided in writing, can be supplemented by a colloquium (§ 11 para. 5 PStO-AB).

## **§ 12 Second resit of examinations**

According to § 19 para. 1 PStO-AB, three graded examinations can be repeated a second time during studies.

## **§ 13 Grade improvement and free attempt (Freiversuch)**

An examination that has not been passed for the first time shall be deemed not to have been taken upon application if it has been taken for the first time before or during the semester recommended in the curriculum (Annex) (free attempt/Freiversuch according to § 21 para. 1 PStO-AB). For grade improvement, § 21 para. 2 PStO-AB applies. A total of up to four free attempts/Freiversuche and grade improvements may be claimed (total quota according to § 21 para. 3 PStO-AB).

## **§ 14 Master's thesis**

(1) The Master's thesis is an examination in the fourth semester according to § 24 PStO-AB. It consists of a written scientific assignment and a final colloquium (§ 24 para. 1 PStO-AB). The grade of the Master's thesis is determined by 4/5 ref. to the arithmetic mean of the grades of the expert opinions and 1/5 of the grade of the colloquium.

(2) Admission to the Master's thesis, in the first step for the preparation of the written scientific assignment, requires the successful completion of at least 80 credit points (ECTS). The topic (task and declaration of the supervising professor) is usually issued at the end of the third semester.

(3) In accordance with § 9 in conjunction with annex 1 PStO-AB, the cooperation agreements and their supplementary agreements for double degree programs may contain provisions that differ from the provisions outlined here.

(4) The thesis covers a workload of 720 hours / 24 credit points and must be completed within six months. The processing period begins at the time determined by the examination board according to § 24 para. 7 PStO-AB. The minimum processing period is four months. The examination board may also approve an earlier submission if a justified application is submitted.

(5) Students are admitted to the final colloquium when they have passed all the examinations and coursework specified in the curriculum, with the exception of the Master's

thesis. The final colloquium involves a talk (presentation) of maximum 30 minutes in which the student presents the results of his or her research, followed by a discussion of approx. 20 to 30 minutes. Six credit points are granted for the final colloquium which usually takes place four weeks after the submission of the thesis, but only after the admission requirements have been met. Two examiners assess the final colloquium. One of the examiners should be the supervising professor.

(6) The supervising professor is responsible for the topic and the supervision of the Master's thesis. The supervisor must be a professor, junior professor, or habilitated employee of one of the IT disciplines or of the Institute of Automation Engineering of the Department of Computer Science and Automation.

(7) Should a student intend to write the Master's thesis outside the IT disciplines or the Institute of Automation Engineering of the Department of Computer Science and Automation, he/she must add the following to the application for admission:

- the approval of the desired institution/company or the desired group, indicating a specialist supervisor with details and proof of his/her qualifications,
- a brief description of the task and content.

(8) The supervising professor is entitled to recommend assessors/examiners according to § 33 para. 1 PStO-AB. One of the assessors/examiners should always be the supervising professor.

## **§ 15 Determination of the overall grade**

The determination of the overall grade follows § 17 para. 5 sentence 1 PStO-AB.

## **D. Final regulations**

### **§ 16 Validity and termination of validity**

(1) These Examination and Study Regulations - Special Provisions - for the degree program Research in Computer and Systems Engineering with the degree "Master of Science" shall be valid on the day after their publication in the University Gazette. They apply to all students enrolled in the summer semester 2022 and later.

(2) As of the end of the summer semester 2024, all other examination regulations - special provisions - and study regulations for the degree program Research in Computer & Systems Engineering with the degree "Master of Science" valid at the time of the effective date of these new regulations shall expire. For students who have not yet completed their studies by the time these regulations expire, the current version of the Examination and Study Regulations - Special Provisions - for the degree program Research in Computer and Systems Engineering with the degree "Master of Science" shall apply.

Ilmenau, 25 February 2022

signed by Univ.-Prof. Dr.-Ing. habil. Kai-Uwe Sattler  
President



## Annex Special admission requirements

1. Admission to the degree program Research in Computer and Systems Engineering requires - in addition to the general admission requirements - the following professional qualifications, which are to be verified in the aptitude test according to § 4 of the Regulations on Admission to Master's Degree Programs at the Technische Universität Ilmenau (MA-ZugO). This aptitude test is to determine whether the applicant meets the special subject-specific requirements for the degree program in Computer and Systems Engineering.
2. The aptitude test is carried out to demonstrate subject-specific aptitude by means of a combination of the subject-specific qualifications named in items 3 and 4 and weighted based on scores.
3. The degree is evaluated according to § 67 para. 1 sentence 1 No. 4 ThürHG as follows:
  - with 40 points in relevant majors or fields of study, for example Computer Science, Computer Engineering, Information Technology, Software Engineering,
  - with 20 points in closely related majors or fields of study, for example Electrical Engineering, Automation.
4. In addition, the level of qualification is assessed according to the final grade of the degree program:
  - a) Very good = 30 points
  - b) Good = 20 points

The final grade of "good" or "very good" in the following subjects or subject groups relevant to the degree program are assessed with 5 points each:

- Software Engineering
- Databases
- Operation Systems
- Communication Networks
- Theoretical Computer Science and
- Automation

A maximum of 15 points can be earned.

5. In addition, the completion of a Bachelor's thesis or an equivalent thesis graded "good" or "very good" or proven qualified professional experience of at least one year will be awarded 5 points.
6. When the applicant achieves a total score of 70 points or more according to the evaluations in sections 3 to 5, the aptitude test is to be evaluated as "Special admission requirements met". Should less than 70 points be achieved, the aptitude test is to be considered as "Special admission requirements not met" (§ 4 para. 4 clause 4, para. 6 clause 1 MAZugO).

7. In case of doubt, the Examination Board shall decide.

# Annex Curriculum

## Version without Internship

Study segments / Modules	Module type (compulsory / elective)	Final Module Score/Exam (Form, duration and details are defined in the module catalogue)	Fachsemester				Total LP	Weighting
			1	2	3	4		
			WS	SS	WS	SS		
			LP	LP	LP	LP		
<b>Basic Studies</b>								
Algorithms	P	MPL		5			5	5
Advanced Database Systems	P	MPL	5				5	5
Software & Systems Engineering	P	MPL	5				5	5
Advanced Mobile Communication Networks	P	MPL		5			5	5
Control Engineering	P	MPL	5				5	5
Research Skills	P	MSL	5				5	0
<b>Advanced Studies</b>								
Choice of modules from the current catalogue	W	5 MPL	25				25	25
<b>Individual Studies</b>								
Research Project	P	MPL			15		15	15
Research Seminar	P	MPL	5				5	5
Group Studies	P	MPL			10		10	10
<b>Soft Skills</b>								
		MSL					5	0
Course from the electives offered by the WM department or the ZIB	W		1					
General language DaF (depending on previous knowledge A1.1 - C1)	W		4					
<b>Master's Thesis</b>								
Master's Thesis with Colloquium RCS	P	MPL				30		
<b>Total LP</b>			30	30	30	30	120	

## Version with Internship

Studienabschnitt / Module	Module type (compulsory / elective)	Final Module Score/Exam (Form, duration and details are defined in the module catalogue)	Fachsemester				Total LP	Weighting
			1	2	3	4		
			WS	SS	WS	SS		
			LP	LP	LP	LP		
<b>Basic Studies</b>								
Algorithms	P	MPL		5			5	5
Advanced Database Systems	P	MPL	5				5	5
Software & Systems Engineering	P	MPL	5				5	5
Advanced Mobile Communication Networks	P	MPL		5			5	5
Control Engineering	P	MPL	5				5	5
Research Skills	P	MSL	5				5	0
<b>Advanced Studies</b>								
Choice of modules from the current catalogue	W	4 MPL	20				20	20
<b>Individual Studies</b>								
Research Project	P	MPL			15		15	15
Research Seminar	P	MPL	5				5	5
Internship	P	MSL			15		15	0
<b>Soft Skills</b>								
		MSL					5	0
Course from the electives offered by the WM department or the ZIB	W		1					
General language DaF (depending on previous knowledge A1.1 - C1)	W		4					
<b>Master's Thesis</b>								
Master's Thesis with Colloquium RCS	P	MPL				30		
<b>Total LP</b>			30	30	30	30	120	

MPL Module examination (graded)  
MSL Module academic achievement  
(graded or non-graded)

LP Credit Points  
P compulsory module  
W elective Modul

## Annex Profile description

### 1. Qualification goals

Today, a strong and increasing software penetration characterizes modern technologies in all fields of economy and personal life. On the one hand, the proportion of devices equipped with programmable processors and interlinked is growing; on the other hand, a large proportion of the processors used are embedded in technical systems in the automotive industry, energy and medical engineering, and mechanical and plant engineering, as well as in everyday devices such as smartphones, washing machines, and refrigerators.

At the interface between hardware and software, there is not only a great demand for specialists who are skilled in both computer science and automation technology and are thus qualified for holistic system-oriented development. In addition, there is also an enormous need for research in this field. The Feldafinger Kreis (a group of influential computer scientists from industry and research who identify the latest trends in ICT), for example, identifies the topics of embedded software-intensive systems, self-managed systems, the Internet of Things, and new driver assistance systems, among others, as technologically and commercially important research trends for Germany in the upcoming years. All these topics are core areas of Computer Science and Systems Engineering.

The aim of the degree program "Research in Computer and Systems Engineering" is to train graduates who are qualified for academic and industrial research in these fields. In addition to in-depth knowledge of computer science, automation technology and other engineering subjects as an area of application, well-founded methodological skills are taught. After completing the program, graduates can successfully apply this knowledge to define and solve complex problems in research and development, to critically evaluate methods and techniques, and to develop them further if necessary. They provide the technical depth and breadth to develop innovative solutions to fundamental issues of software-intensive systems and are also able to independently familiarize themselves with future IT technologies. Social skills such as teamwork, communication skills, and international and intercultural experience prepare them for management tasks and enable them to set up and manage projects. They are also qualified to carry out scientific work with the objective of achieving a doctorate.

Therefore, the Master of Science as a consecutive research-oriented, university-based degree program relies on the education as a Bachelor of Science in Computer Science, Computer Engineering, Computer and Systems Engineering and comparable (international) degree programs as well as optionally on relevant professional experience. Due to the strong research orientation, the goal of preparing students for research work in companies or universities, and with regard to attracting suitable candidates from Germany and abroad, the program is internationally oriented, and English is the language of instruction.

Graduates of the Master's program Research in Computer and Systems Engineering will have acquired the following professional competence and social skills:

#### **Knowledge, understanding, and comprehension**

The graduates provide a broad and in-depth knowledge, which they have gained from their completed bachelor's degree. They understand the scientific fundamentals and the state of the art of research in the subfields of computer science, automation technology and mechanical and plant engineering. They can identify interconnections within subfields as well as related topics and to find innovative solutions to problems in the holistic balancing of requirements for heterogeneous systems. They apply scientifically based methods and models and validate the results.

Graduates have gained detailed knowledge of the structure and functions of information-intensive technical devices and systems. They know and understand the processes used in them, can analyse, evaluate, and apply them and design new methods and systems. They provide detailed and critical understanding at the cutting edge of knowledge of hardware and software in the various fields of application. They are also able to classify and weigh up contradictory or incomplete research results and proposals. Their knowledge and understanding forms the basis for the research-oriented development and/or application of independent ideas. They can deepen the knowledge independently which they have gained in their studies through professional experience and the study of specialist literature and to update it with the advancing state of research.

### **Use, application, and generation of knowledge**

Graduates will effectively apply their knowledge, understanding, and problem-solving skills to new and unfamiliar situations involving a broader or multidisciplinary context of computer and systems engineering.

#### **Graduates**

- have gained fundamental skills enabling them to develop innovative solutions based on the international state of the art, to understand and develop new applications, and to implement research and development results in the context of the synthesis process;
- are able to independently learn and apply the current state of research in the fields of software development and systems engineering;
- can identify and define research questions and answer them using scientific methods;
- are able to develop innovative concepts and solutions for basic research-oriented questions involving other disciplines;
- are qualified to do scientific work aiming at a doctoral degree.

In the field of "Advanced Studies" of the degree program, graduates also acquire the following professional qualifications:

- Using current research tasks, they acquire the ability to correctly apply methods known to them and to integrate them into the development process. They recognize and evaluate the appropriate modelling, solution or analysis procedures in specified application conditions and solve related tasks appropriately.
- Students have gained knowledge and understanding of the structure and operation of modern cellular mobile communication systems, in particular GSM, GPRS/EDGE, UMTS, LTE and 5G and their protocols.

- Graduates understand in detail the structure and functioning of complex embedded computer systems. They understand the real-time, communication and software aspects to be considered in embedded systems. Students consider safety, reliability, and power consumption in design. The students have gained knowledge in the design domain automotive.
- Graduates understand the theoretical foundations of neural networks and deep learning in particular. They can analyse architectures, recognize their fields of application and design, and implement corresponding solution approaches.
- They know the basics of distributed and parallel data management solutions. They understand the principles of these techniques and can develop their own solutions based on them. Graduates can explain techniques for query processing, replication and consistency management and evaluate them in terms of their advantages and disadvantages for different purposes.
- Graduates can design models of complex systems using a wide range of methods.
- They can identify and define optimization problems and solve them by selecting suitable methods. Furthermore, they critically evaluate and validate their solution.

## **Communication and cooperation**

### Graduates

- provide social skills such as teamwork and communication skills, international and intercultural experience, social, ecological and ethical awareness and are therefore well prepared for leadership tasks such as managing and setting up projects;
- can work on a task in a team. They can plan the design of a holistic solution for problems in the field of specialization of the studies, prepare an implementation and critically analyse and document their results during validation. For this purpose, they have also acquired the necessary skills and competencies in terms of organization, communication, project management, time management and conflict resolution;
- Graduates consider different perspectives and interests of third parties.

## **Scientific self-image and professionalism**

### Graduates

- develop a professional self-image guided by goals and standards of professional action of industrially and academically based professional fields,
- Graduates support their own professional actions by applying theoretical and methodological knowledge,
- can assess their own abilities, autonomously consider relevant design and decision-making options, and use them independently,
- recognize situationally appropriate framework conditions for professional action and motivate their decisions responsibly and ethically,
- are able to evaluate fundamental interactions between technology and society as well as ethical aspects and consider them in the development of technological products/devices,
- critically review their professional actions in terms of societal expectations and consequences.

## **2. Content-related main aspects and course of studies**

The degree program "Research in Computer and Systems Engineering" is divided into four phases. The subject of the first phase (Basic Studies, with 30 credit points) focuses on standardizing the level of the students through compulsory courses in the core subjects Software & Systems Engineering, Computer Architectures, Information and Communication Systems, Theoretical Computer Science and Automation Engineering. Furthermore, students gain competencies in independent scientific work, the preparation of scientific publications and the presentation of technical aspects in a Research Skills Seminar.

In the second phase (Advanced Studies, with 25 credit points), students deepen their knowledge by participating in five elective modules from a catalogue organized in concentrated, project-oriented classes supplemented by intensive self-study. These elective modules are focused on the specific professional goals of the degree program.

The third phase (Individual Studies, with 40 credit points) consists of classes designed to develop competencies in project-oriented and independent work and these classes must be attended in parallel. Teamwork is deepened in the Group Studies module and independent working methods in the Research Project, both of which are based on the specific subject modules. The tasks for these projects relate to current research topics in the participating subject fields and in this way promote scientific training by involving the students in ongoing research projects. As an alternative to the Group Studies module, students can also choose a specialized internship of several weeks in relevant IT companies.

The fourth and final phase of the program is the Master's thesis, which takes six months to complete. Current research projects in the Groups also provide the topics for the Master's thesis. Due to the early involvement of the students in the research work during the second and third phase and the intensive supervision, an efficient processing of challenging topics is guaranteed.

## **3. Demand for graduates in industry**

Students of the described profile study in degree programs known as "Computer and Systems Engineering" or "Computer Engineering" at several German universities. These programs are run by the faculties of computer science, electrical engineering/information technology and, in some cases, mechanical engineering. However, the number of graduates is rather low compared to the traditional programs in computer science, electrical engineering, and mechanical engineering. In contrast, there is a high demand from companies and research institutions, as evidenced by the demand for graduates of the related diploma and Master's degree programs in Computer and Systems Engineering. Today, graduates of electrical engineering and computer science still perform many of the activities covered by the degree program profile. However, they can only do so effectively after a longer training period, during which the deficits of the missing second discipline must be compensated for.

Various studies predict a stable or increasing demand for computer science graduates with in-depth engineering knowledge over a period of more than five years. According to the "Dagstuhl Manifesto on the Strategic Significance of Software Engineering in Germany" [Bro06]: "The traditional strength of German industry, such as automotive engineering, is in engineering-oriented secondary sectors. However, innovation and world market leadership are increasingly characterized by engineering, software-intensive individual solutions." The trend statements of the Feldafinger Kreis also emphasize the importance and need for research of software-intensive solutions in all technical fields and thus allow the identification of a high demand for qualified graduates.

The career prospects for graduates of the Master's program "Research in Computer and Systems Engineering" at the TU Ilmenau may be considered excellent in the medium and long term, both nationally and internationally. The main fields of activity for graduates are among others:

- Technical Information Systems
- Industrial automation and control technology
- Embedded computer systems
- Automotive engineering
- Aerospace industry
- Mobile robotics
- Medical engineering
- Communication technology
- Intelligent measurement and sensor technology
- Power engineering.

In addition, the completion of this research-oriented degree program qualifies students to work with the goal of a doctorate at industrial and academic research centres. Due to the broad subject matter of the program, the above-mentioned fields are open to the graduates and offer a versatile development potential.



## **Annex Regulations for practical training**

### **1. The objective and purpose of practical vocational training**

(1) Students should gain insight into the processes that are essential in the use of scientifically based methods in the design, implementation, evaluation, and use of complex systems in an area of application (e.g., industry, technology, business, medicine, administration, or research) by their own observation and cooperation during the specialized internship. Therefore, students should be introduced to the professional activities of a graduate with the degree "Master of Science" in the field of computer science or systems engineering.

(2) Students of the program Research in Computer and Systems Engineering with the degree "Master of Science" can optionally complete a specialized internship with 15 credit points in one semester of the four-semester program. When choosing this option, the corresponding curriculum with specialized internship applies. (Annex Curriculum).

(3) The purpose of the specialized internship is to familiarize students with work processes and methods as well as with organizational and social aspects in companies and institutions and to introduce them to their later professional activities. In the specialized internship, the students are to gain general knowledge and experience, through their own observation and cooperation, which are significant for entering the labour market and for the initial orientation in their later professional activity and which can only be gained in a typical company environment. They should gain insight into the processes that are essential in the use of scientifically based methods in the design, implementation, evaluation, and application of concepts. The specialized internship supports deepening the knowledge acquired during the studies in its practical relevance and to already apply it practically to a certain extent. Furthermore, the internship serves to understand the sociological relationships within a company, as students gain an understanding of the social structure of the company and become familiar with the relationship between managers and employees.

### **2. Length and structure of the practical vocational training**

(1) The practical training in the specialized internship shall cover a total of at least ten weeks (50 days of internship).

(2) It is not possible to split the specialized internship between different companies or authorities.

(3) The specialized internship should be done during the third semester due to the desired qualified activities.

(4) In general, one week of the internship covers five days with the regular weekly working hours of the respective company applicable for this period. Missed days (vacation, illness, company vacation, shutdown, short-time work, etc.) must be made up to the extent that

the required internship period is not fallen short of by more than one week. Public holidays are not required to be made up.

### **3. Content and professional requirements for the practical vocational training**

(1) The specialized internship includes practical activities applying scientific methods in an industrial environment or in an operational environment to design, implement, evaluate, use and maintain complex computer science systems. An appropriate task is to be processed under practical conditions, whereby preferably both teamwork and the independent processing of subtasks should be of importance. General conditions of the industrial environment such as teamwork, deadlines and adherence to deadlines, economic issues, quality management, data protection and environmental compatibility are to be experienced. The internship also serves to experience the social structure in companies and to further practice soft skills.

The specialized internship includes activities in computer science or systems engineering from one or more of the following fields:

- Software engineering, software development environments, software tools, programming languages and translation;
- Databases, documentation systems, information systems, knowledge-based systems;
- Knowledge processing systems, teaching and learning systems, image analysis, neural networks, cognitive systems, robotics, computational linguistics;
- Operating systems, distributed computer systems, real-time systems, computer networks, telematics, communication in networks, office systems, distributed applications;
- Graphic systems, visualization, CAD/CAM/CIM systems, animation, multimedia;
- Functional principles and evaluation of computer systems, functional computer design, design of hardware components, modelling and simulation of digital systems;
- Design and implementation of logic circuits and networks, design methodology and design tools for VLSI, digital fault diagnosis, simulation and verification of digital systems;
- Multiprocessor and multicomputer systems, process computing, innovative computer architectures, application-oriented architectures, embedded systems;
- Application of computer science knowledge from these areas in technical and non-technical fields and in research.

(2) A professor of the Department of Computer Science and Automation, who is appointed by the examination board on application of the student and who is appointed as an examiner (§ 33 PStO-AB), and a company supervisor are responsible for the supervision of the students during the internship.

(3) The students must register the specialized internship with the examination office in a timely manner prior to the beginning of the activity. A detailed task description (max. one A4 page) with the contact details of the supervisor of the internship institution/company

must be attached to the registration form using a sheet of paper with the institution's/company's official header. The task description must be signed by the supervisor of the internship institution/company. In addition, the supervisor's declaration signed by the supervising university instructor of a Group of the Department of Computer Science and Automation, or the Department of Electrical Engineering and Information Technology is to be submitted with this application, confirming the principle recognizability of the internship with the intended task and declaring the readiness to examine/assess the report and accept the defence according to Section 7, Paragraph 2.

(4) The students can apply for special regulations for the internship at the responsible examination board to compensate for disadvantages (§ 28 PStO-AB).

(5) When registering for the specialized internship, the student is recommended to have already earned at least 20 credit points in the degree program.

#### **4. Companies and institutions for practical vocational training**

Non-university research centers as well as private companies that plan, manufacture, support or operate complex systems can be considered for the specialized internship. The university instructors assist in the selection of a suitable internship company. Before concluding the internship contract, the students are required to coordinate the choice of the internship company and the internship activity with the supervising university instructor.

#### **5. Internship agreement**

The students are responsible for the selection and organization of the suitable internship location (also worldwide). They sign an internship agreement with the provider in question. To prepare the recognition of the internship, section 7 paragraph 4 is to be considered and in case of doubt it is recommended to consult the examination office in advance.

#### **6. Proof of professional practical training**

(1) The students shall provide proof of the specialized internship by submitting

- an original internship certificate with company stamp and signature
- an evaluation form, which is provided by the Department of Computer Science and Automation, and which is to be filled out by the supervisor in the company and
- an internship report.

(2) The internship certificate must cover the following information:

- Personal data of the student (surname, first name, date of birth),
- Internship period,
- Training company, department, address,

- Fields of training, indication of duration and tasks,
  - Details of days absent (even if there were none),
  - Proof of making up for lost time (only if applicable),
  - Signature of the company supervisor and company stamp.
- It may be issued in German or English.

The scientific-technical report on the internship task as well as on further experiences gained during the internship should not exceed 15 to 20 pages with a generally accepted font size (12 pt). The internship report must also permit the recognition and comprehension of the activities performed, even if the provisions of data protection and corporate secrecy are observed. Approval of the internship report by the supervisor in the company (date, name, signature, and company stamp) is required.

## **7. Professional recognition of practical vocational training**

(1) The professional recognition of the specialized internship is confirmed by the supervising university instructor. The students submit the documents required according to number 6 paragraph 1 to the examination office of the Department of Computer Science and Automation.

(2) The scientific-technical report is to be defended in a 20 to 30-minute presentation and possibly a subsequent discussion of the results before the university supervisor, who decides on the recognition of the specialized internship based on the submitted documents and the defence. He/she may request (once) the rectification/improvement of the report and the repetition of the defence. The university supervisor issues a non-graded certificate of achievement on the recognition of the internship and the granting of the 15 credit points.

(3) For the decision on the professional recognition § 37 PStO-AB applies.

## **8. Crediting and recognition of substitute periods**

(1) Crediting and recognition of professional activities completed prior to the start of the degree program is explicitly excluded.

(2) The examination board decides on the recognition of a specialized internship completed as part of another degree program at the university or another institution of higher education in accordance with § 54 para. 5 ThürHG in conjunction with § 26 para. 1 PStO-AB. § 26 para. 1 PStO-AB.

(3) For the decision on the professional recognition § 37 PStO-AB applies.

## **9. Practical training abroad**

(1) The completion of the specialized internship abroad is strongly recommended only for students with a German university entrance qualification. Corresponding activities must

comply in all respects with these regulations on professional practical training. Should the certificate not be written in German or English, a notarized translation is to be provided.

(2) For the search for an internship abroad, it is also possible to rely on various exchange programs - for example, the German Academic Exchange Service (DAAD). However, the provided internship does not automatically meet the necessary criteria and requirements. The student must clarify these issues on his or her own responsibility.

## **Annex Competence goals and regulatory field – elective course catalogues**

The Research in Computer and Systems Engineering program leading to the degree of Master of Science includes the elective field of Advanced Studies.

### **1. Elective field Advanced Studies**

(1) To individualize and specialize their studies, students gain in-depth knowledge and competencies in self-selected subfields of computer science and / or electrical engineering and information technology in the electives.

(2) According to the curriculum (Annex Curriculum), students must earn 25 credit points in the field of electives. In the case of the program model with a specialized internship, only 20 credit points are to be earned in the field of electives.

(3) Students may select modules from the catalogue at their own discretion.

(4) According to § 3 paragraph 7 PStO-AB, the elective catalog may be updated.