Dresden University of Technology
Department of Computer Science

Curriculum Requirements for the International Master's Program in Computational Engineering at the Dresden University of Technology

As of 07/09/2004

On the basis of §21 of the „Gesetz über die Hochschulen im Freistaat Sachsen" (Sächsisches Hochschulgesetz – SächsHG / Saxon law on higher education in Saxony) of June 11, 1999 (SächsGVBl. S. 293 / Saxon gazette of laws and by-laws, p. 293), amended by law of June 28, 2001 (SächsGVBl., pp. 426, 428), the Dresden University of Technology is enacting the Curriculum Requirements hereinafter called as ordinance.

§ 1
Scope

These Curriculum Requirements set the objective, contents, and course of action of studies in the international Master's program in Computational Engineering on the basis of the "Sächsisches Hochschulgesetz" (Saxon law on higher education) and the examination regulations.

§ 2
Objective of the Program

(1) The objective of the program is to equip the student with in-depth theoretical and practical expertise necessary for professional employment, to provide him or her with an overview of the individual disciplines of the field of Computational Engineering, and to improve his or her skills in working with scientific methods. In addition, the student will be provided with an opportunity to shape his or her studies in relation to the desired field of activity. In order to gain the knowledge needed in specific fields of activity, the student may choose respective module combinations and, thus, push his or her education in a certain direction. With the help of stays abroad as well as English as teaching and working language, the student shall be prepared for the increasing internationalization of science, business and industries.

(2) The main focus of the academic training will be on the transfer of knowledge in the classic fields of system architecture, such as Operating Systems, Databases, Computer Networks, System Security, and Real-time Systems, complemented by the fields of Software Engineering as well as Modeling and Simulation Technology.

(3) The Master's examination constitutes the postgraduate certificate, qualifying for profession as well as research, of the international Master's program in Computational Engineering. It is to assess the candidate's ability to identify interrelations in his or her field, to determine whether he or she has gained the expertise and skills necessary for professional work, and to ascertain the candidate's ability to independently apply scientific methods and knowledge. Upon successful passing of the Master's examination, the Curriculum Requirements will award the academic degree of "Master of Computer Science" (abbr.: M.C.S.). The certificate and its translation will include an annotation stating that the academic degree has been acquired in the international Master's program in Computational Engineering.

§ 3
Admission Requirements

(1) Applicants in the international Master's program in Computational Engineering have to meet the following requirements:

1. Proof of basic knowledge of English in the form of an IELTS certificate or comparable proof. Applicants whose mother tongue is English are exempted from this rule.
2. Bachelor in Computer Science, with a standard period of study of at least six semesters, or another university degree qualifying for profession that has been declared equal by the Examination Board.
3. Proof of at least firm or substantial knowledge respectively in the fields of
   - programming, including practical experience with at least one higher programming language,
   - basics of operating systems, computer networks, database management systems, and software engineering,
   - mathematical and electro-technical basics of applied computer science.
4. The requirements stated under point 3 can be met by providing proof in the form of certificates, examination certification, or any other written confirmation documents.

(2) The Examination Board responsible for this program will decide about the fulfillment of the requirements stated in Section 1.

(3) Students will be enrolled at the Dresden University of Technology in accordance with the existing regulations for this process.

§ 4
Commencement of Study, Duration of Study

(1) For first-year students, the course of studies will usually commence in the fall term.

(2) The standard period of study, including the writing and defense of the Master's thesis, is two years (four semesters).

(3) Students who have acquired the necessary prerequisites according to § 3 Sec. 1, No. 2 at a German University will usually be required to spend one semester of their standard period of study at a university abroad. The stay abroad may also be used for writing the Master's thesis under the supervision either of a professor associated with the foreign university or a scientist associated with a foreign research institution. Upon request, the Examination Board of the international Master's program in Computational Engineering will decide about time and commencement of the stay abroad. Likewise, the Examination Board will decide about possible exceptions from these regulations in individual cases upon request. In due time before the commencement of a stay abroad, the student shall consult a professor about the courses to be attended at the foreign university or the topic of the Master's thesis.

§ 5
Forms of Courses

(1) The teaching contents are structured in modules. In each individual module, knowledge will be transferred, consolidated, and deepened through lectures, tutorials, seminars and labs.

(2) In lectures, the subject matter will be taught. Practical sessions and tutorials accompany the lectures and are used to work through the lecture's topics and, if necessary, to broaden one's knowledge. In these sessions, students are to discuss their solutions to exercises in functional groups under supervision. Seminars are to improve a student's skills in researching into a certain field with the help of available literature, documentations, and miscellaneous documents, and in presenting and arguing for the gathered information. Lab sessions are used for the practical implementation and broadening of gained knowledge as well as for the acquirement of practical skills in working with hardware and software.

(3) The language for teaching, working, and examinations is English. Students may take oral exams in German.

§ 6
Structure and Course of Action of the Program

(1) The course offerings span three semesters. They comprise courses with a total scope of 90 ECTS points (credits; abbr.: cr.).

(2) The academic training is divided into a mandatory part for every student (mandatory modules) and an elective part (elective modules) where students can choose freely. It includes:

- 42 cr. for mandatory modules,
- 36 cr. for electives and
- 12 cr. for an internship
- 30 cr. for the Master's thesis and its defense

(3) The distribution of the modules over individual semesters is available in the enclosed course schedule (appendix 1).

(4) The course of action for the internship will be issued to the student in due time in the form of a document with internship regulations by the Examination Board of the international Master's program in Computational Engineering.

(5) The educational objectives for each module, the necessary prerequisites, and the interrelations between the modules can be found in the module descriptions in appendix 2.

(6) In the concluding writing of the Master's thesis, the student shall prove his ability to handle a problem in the field of Computational Engineering or its applications with scientific methods on his or her own.

(7) The course of studies will conclude with the Master's examination.

(8) It is recommended that the student broaden his or her knowledge, abilities, and skills gained during his or her studies in practical professional work.

§ 7
Examinations and ECTS Credit Point System

(1) The course of studies will conclude with the Master's examination. The Master's examination consists of two parts, one of them being the module examinations and the other being the Master's thesis including its defense. Module examinations will be taken concomitantly during one's studies. Grades for module examinations will be given in accordance with the ECTS scale and with verbal equivalents according to § 11 Sec. 1 of the examination regulations.

(2) ECTS credit points are awarded only if a module examination has been passed. The ECTS credit point system provides a consistent course of action for the crediting of study work having been done abroad.

§ 8
Advisory Service

Advice in matters related to the course of study or examinations, admission requirements or change of university, stays abroad as well as any other matter related to this program will be given by the team of advisors of the Department of Computer Science, and corresponding to the international character of the Master's program this may also occur via Internet.

§ 9
Commencement and Announcement

(1) These Curriculum Requirements will apply to students enrolled since the fall term of the 2004/05 academic year.

(2) These Curriculum Requirements become effective as of 10/01/2004 and will be announced in the official notices of the Dresden University of Technology.

Issued on the basis of the Senate resolution from 01/15/2003 and with approval of its announcement from the Sächsische Staatsministerium für Wissenschaft und Kunst (Saxon ministry for arts and science) of 08/08/2003.

Dresden, 01/06/2004

Chancellor of the
Dresden University of Technology

Prof. Hermann Kokenge

Appendix 1: Course Schedule with Credit Points

Module	Semester 1	2	3	4
M1: Systems Engineering	9			
M2: Ubiquitous Information Systems	11			
M3: Distributed and Secure Platforms	11			
M4: System Design and Analysis	11			
Electives	0	18	18	
Internship			12	
Master's Thesis				30
Total	**30**	**30**	**30**	
Total cr.	**90**			

The mandatory modules M1 to M4 span the first year of studies. The distribution of courses among these modules will be specified in the module descriptions, in which necessary study work shall be considerately distributed with a proportion of 5:2 to the first and second semester in order to ensure a consistent course load when it comes to attending courses from elective modules during the second semester.

Appendix 2: Module Descriptions for Mandatory Modules

Module Number	**Module Name**	**Instructor in Charge**
M 1	Systems Engineering	Prof. Fetzer

Contents and Objectives:	This module introduces the basics of design, development, and operation of computational systems. This module will provide an overview of the structure of such systems, which usually consist of different hardware layers and software components. Special focus will be put on non-functional aspects of systems, such as reliability and availability, as well as on methods for providing these non-functional aspects. Studying existing systems will broaden this knowledge.
Forms of Courses:	This module consists of two lectures with accompanying tutorials with a total scope of 4 SWS (i.e., 4 hours per week, where an hour is 45 minutes) each. In the lectures, the theoretical fundamentals will be taught. The tutorials consist of solving several exercise problems in order to deepen the knowledge of the lectures' contents. The instructor in charge will provide the students with the exact descriptions of the lectures in due time.
Prerequisites for Participation:	Basic knowledge in the fields of system architecture, modularization and structuring of complex systems.
Usability of this Module:	Free combination with any other module of the program is possible. The courses offered in this module are also used in the same form in the Diploma Programs „Computer Science“, Multimedia Computer Science“ and „Information System Technology“.
Requirements for Acquiring Credits:	For each course, examination performances shall be assessed independently from each other in oral examinations with a duration of 20 – 30 minutes and with the focus being on the comprehension of overall concepts. For a larger number of students, examination performances shall be assessed through a written examination with a duration of 60 minutes. The instructor in charge will announce the form of the examination to the students in due time.
Credit Points and Grades:	9 credit points can be acquired for this module. The module grade results from the arithmetic average of all individual examination grades, each with a weighting correlating to the expected amount of work for the individual course.
Frequency of Module Offerings:	This module will be offered every academic year.
Expected Work Load:	The expected workload is 270 work hours (attendance at lectures and tutorials, preparation and reviewing, and examination preparation). The workload is equally distributed to both courses offered in this module.
Duration of Modules:	The courses are distributed to the first two semesters.

Module Number	Module Name	Instructor in Charge
M 2	Ubiquitous Information Systems	Prof. Dr. A. Schill/ Prof. Dr. W. Lehner

Contents and Objectives:	This module will provide an overview of middleware architecture and platforms for the development of distributed applications and information systems. In doing so, the focus will be both on the intensive discussion of the field of mobile communication or mobile processing and on the transactional processing in distributed environments (especially with regard to large information systems). The students will learn to identify and develop concepts and architectures for distributed and omnipresent application and information systems, to choose appropriate solutions, and to evaluate modern technological developments in this field.
Forms of Courses:	This module consists of two lectures with accompanying tutorials with a total scope of 4 SWS each. In the lectures, the theoretical fundamentals will be taught. The tutorials consist of solving several exercise problems in order to deepen the knowledge of the lectures' contents. In particular, the following courses will be offered: - Middleware and Mobile Systems: The technologies to be discussed include, for example, distributed communication techniques, distributed object-oriented systems, multi-stage architectures, component-based service infrastructures and related tools. Regarding the field of mobile systems, the main focus will be on cellular radio networks, wireless local networks, mobile Internet protocols as well as on several mobile system and application platforms. - Transactional Information Systems: This lecture will provide a deeper understanding of the structure of large – and also spatially distributed – information systems. In particular, detailed information on techniques and methods for database concepts both from the perspective of modeling and of system architecture will be given.
Prerequisites for Participation:	Basic knowledge in the fields of computer networks, operating systems (for example based on specialized books such as „Tanenbaum: Computer Networks") as well as modeling and architecture of databases including transaction processing.
Usability of this Module:	Free combination with any other module of the program is possible. The courses offered in this module are also used in the same form in the Diploma Programs „Computer Science", Multimedia Computer Science" and „Information System Technology".
Requirements for Acquiring Credits:	For each course, examination performances shall be assessed independently from each other in oral examinations with a duration of 20 – 30 minutes and with the focus being on the comprehension of overall concepts. For a larger number of students, examination performances shall be assessed through a written examination with a duration of 60 minutes. The instructor in charge will announce the form of the examination to the students in due time.
Credit Points and Grades:	11 credit points can be acquired for this module. The module grade results from the arithmetic average of all individual examination grades, each with a weighting correlating to the expected amount of work for the individual course.
Frequency of Module Offerings:	The module will be offered every academic year.
Expected Work	The expected workload is 330 work hours (attendance at lectures and tutorials, preparation and reviewing, and examination preparation). The

Load:	workload is equally distributed to both courses offered in this module.
Duration of Modules:	The courses are distributed between the first two semesters.

Module Number	**Module Name**	**Instructor in Charge**
M 3	Distributed and Secure Platforms	Prof. Dr. H. Härtig Prof. Dr. A. Pfitzmann

Contents and Objectives:

In this module, further topics related to the construction of distributed and secure systems from the perspective of data security in general and of the development of security architecture within the context of distributed operating systems in particular will be discussed.
Participants shall gain substantiated understanding of the problems discussed, while on the one hand, fundamental topics such as scalability, fault tolerance, and robustness will be demonstrated considering the implementation of modern micro-kernel-based construction principles as example, and on the other hand, protection objectives and mutual dependencies will be clarified. Furthermore, students are expected to understand the interaction with related fields such as database development and computer architecture. We will put special focus on enabling participants to evaluate recent developments on their own.

Forms of Courses:

This module consists of two lectures with accompanying tutorials with a total scope of 3 and 4 SWS respectively. In the lectures, the theoretical fundamentals will be taught. The tutorials consist of solving several exercise problems in order to deepen the knowledge of the lectures' contents while important insight will also be gained partly through collective research into specialized literature.
In particular, the following courses will be offered:

- Distributed Operating Systems: This lecture will discuss different architectures within the context of distributed operating systems, their underlying principles, and even foundation-oriented modeling as well as practical aspects of implementation, while topics such as scalability, robustness, fault tolerance, parallel architectures and clusters, and distributed file systems will be focused on in particular.
- Security and Cryptography: This lecture will provide an in-depth introduction to data security in general and to multilateral security of IT systems in particular. Protection objectives and their mutual dependencies as well as appropriate attack models will be discussed, and different kinds of security mechanism will be introduced. Cryptosystems represent fundamental security mechanisms for achieving the protection objectives of confidentiality and integrity in distributed systems, and thus, will be discussed to appropriate extend.

Prerequisites for Participation:

Basic knowledge in the fields of operating systems, computer architecture, databases, and software engineering.

Usability of this Module:

Free combination with any other module of the program is possible.
The courses offered in this module are also used in the same form in the Diploma Programs „Computer Science“, Multimedia Computer Science“ and „Information System Technology“.

Requirements for Acquiring Credits:

For each course, examination performances shall be assessed independently from each other in oral examinations with a duration of 20 – 30 minutes and with the focus being on the comprehension of overall concepts. For a larger number of students, examination performances shall be assessed through a written examination with a duration of 60 minutes. The instructor in charge will announce the form of the examination to the students in due time.

Credit Points and Grades:

11 credit points can be acquired for this module.
The module grade results from the arithmetic average of all individual examination grades, each with a weighting correlating to the expected amount of work for the individual course.

The module will be offered every academic year.

Frequency of Module Offerings:	
Expected Work Load:	The expected workload is 330 work hours (attendance at lectures and tutorials, preparation and reviewing, and examination preparation). The workload is equally distributed to both courses offered in this module.
Duration of Modules:	The courses are distributed to the first two semesters.

Module Number	**Module Name**	**Instructor in Charge**
M 4	System Design and Analysis	N.N.

Contents and Objectives:

This module will provide information on fundamental methods, construction elements, and notation for the systematic development of larger software systems as well as the methodology for modeling and simulation of discrete event systems. The framework for this module will be given through the software development process with its lifecycle and phase models, and in addition to that, through the implementation of simulation and modeling techniques for the development of large and flexible application systems. Upon completion of this module, students shall be able to contribute to the development of large software systems according to the consolidated stage of technology and to apply the methodology of system analysis in practical scenarios.

Forms of Courses:

This module consists of two lectures with accompanying tutorials with a total scope of 4 SWS each. In the lectures, the theoretical fundamentals will be taught. The tutorials consist of solving several exercise problems in order to deepen the knowledge of the lectures' contents and of practical and project-oriented work with software development tools and simulation software.

In particular, the following courses will be offered:

- Engineering Large Software Systems: The focus will be on the introduction of general object-oriented development methodology. For specification of object-oriented layouts, UML will usually be used. As an important construction element for the translation of software layouts into executable programs, an object-oriented programming language (e.g. Java) will be used, which will usually be taught as second programming language in this module. Central issues are need analysis, the development – including recycling technologies (class libraries, frameworks, design patterns, software components) – of and the implementation techniques for complex distributed systems. Issues related to the securing of software quality and to software evolution will conclude the process of learning about the software lifecycle.
- Modeling and Simulation: This lecture addresses sub-fields of model theory and paradigms for describing discrete systems, simulation approaches for event-discrete systems, data modeling and analysis of stochastic data streams, basics of simulation languages and simulation tools, the acquisition of one simulation language and skills in working with one simulation tool. The state of knowledge gained in this course will enable students to apply simulation in a practical form as a method for system analysis in various application fields, and to adequately interpret the results gained through the simulation process.

Prerequisites for Participation:

Basic knowledge and practical experience in the following techniques: principles of object-orientation, programming with Java, modeling with UML (class diagrams, state diagrams, sequence diagrams), knowledge of calculus of probabilities and statistics

Usability of this Module:

Free combination with any other module of the program is possible.
The courses offered in this module are also used in the same form in the Diploma Programs „Computer Science“, Multimedia Computer Science“ and „Information System Technology“.

Requirements for Acquiring Credits:

For each course, examination performances shall be delivered independently from each other in oral examinations with a duration of 20 – 30 minutes and in the completion of a practical task. The instructor in charge will announce the form of the examination to the students in due time.

Credit Points and Grades:	11 credit points can be acquired for this module. The module grade results from the arithmetic average of all individual examination grades, each with a weighting correlating to the expected amount of work for the individual course.
Frequency of Module Offerings:	The module will be offered every academic year.
Expected Work Load:	The expected workload is 330 work hours (attendance at lectures and tutorials, preparation and reviewing, and examination preparation). The workload is equally distributed to both courses offered in this module.
Duration of Modules:	The courses are distributed to the first two semesters.

Appendix 3: Offerings of Elective Modules

The list of modules in the elective part will be updated by the Examination Board of the international Master's program in Computational Engineering at the beginning of every academic year, and it shall be announced to the students in due time. To serve as an example, three modules of the elective part will be listed here:

Module Number	**Module Name**	**Instructor in Charge**
MW 1	Introduction to Computational Logic	Prof. Dr. S. Hölldobler
Contents and Objectives:	This module provides an in-depth introduction to the field of Computational Logic. In doing so, the main issues as well as a variety of methods and techniques will be discussed. After an initial review of the basics of propositional logic and first-order logic, the topics of „Equational Reasoning", the principles of deduction, abduction and induction, non-monotonous inference, logic-based program development, processing of natural languages and „Machine Learning" will be discussed.	
Forms of Courses:	This module consists of one lecture with a total scope of 4 SWS and tutorials with a scope of 2 SWS. In the lecture, the theoretical fundamentals will be taught, which will be discussed further within the framework of the tutorials. The instructor in charge shall announce the title of the lecture to the students in due time.	
Prerequisites for Participation:	Basic knowledge in the fields of theoretical Computer Science.	
Usability of this Module:	Free combination with any other elective module of the program is possible. The courses offered in this module are also used in the same form in the international Master's program in Computational Logic".	
Requirements for Acquiring Credits:	Successful completion of homework within the framework of the tutorials and successful participation in the module examination.	
Credit Points and Grades:	7 credit points can be acquired for this module. The module grade will be determined by the final written module examination with a duration of 90 minutes and the grade for the homework taken into consideration with a weighting of 20 %.	
Frequency of Module Offerings:	This module is offered during the fall term of every academic year.	
Expected Work Load:	The expected workload is 210 work hours (attendance at lectures and tutorials, preparation and reviewing, and examination preparation).	
Duration of Module:	Course spans one semester.	

Module Number	**Module Name**	**Instructor in Charge**
MW 2	Real-time Systems	Prof. Dr. H. Härtig

Contents and Objectives:	This module discusses real-time systems, that is to say systems whose correct functioning depends on the observation of timeliness agreements. As a first step, the course will discuss the fundamentals - modeling of load and recourses, - time, clocks, and clock synchronization, - time-controlled vs. event-controlled construction - scheduling procedures. Building on that, topics related to real-time systems from all sub-fields of Computer Science will be discussed. Among these are - real-time programming languages, synchronous and event-controlled - real-time operating systems, - real-time systems and hardware, micro-controller, caches - real-time communication in field busses and wide area networks and - application of real-time systems. First of all, the central objective of this module is to provide the fundamentals of real-time processing, and then to emphasize that the construction of real-time systems requires comprehensive thinking about many different sub-fields of Computer Science.
Forms of Courses:	This module consists of one lecture with a scope of 2 SWS and tutorials with a scope of 1 SWS. In the lecture, the theoretical fundamentals will be taught. The tutorials consist of solving several exercise problems in order to deepen the knowledge of the lectures' contents and of collective research into specialized literature. The instructor in charge shall announce the title of the lecture to the students in due time.
Prerequisites for Participation:	Basic knowledge in the fields of operating systems, computer architecture, databases, and software engineering.
Usability of this Module:	Free combination with any other module of the program is possible. The courses offered in this module are also used in the same form in the Diploma Programs „Computer Science", Multimedia Computer Science" and „Information System Technology".
Requirements for Acquiring Credits:	Successful participation in the final module examination.
Credit Points and Grades:	5 credit points can be acquired for this module. The module grade will be determined by a final oral module examination with a duration of 20 to 30 minutes.
Frequency of Module Offerings:	This module is offered during the spring term of every academic year.
Expected Work Load:	The expected workload is 150 work hours (attendance at lectures and tutorials, preparation and reviewing, and examination preparation).
Duration of Module:	Course spans one semester.

Module Number	**Module Name**	**Instructor in Charge**
MW 3	Design and Implementation of Database Systems	Prof. Dr.-Ing. W. Lehner
Contents and Objectives:	This module is used for comprehensive discussions of further technologies in the field of database systems. Essentially, those structural as well as operational characteristics will be given extensive consideration which are necessary to implement scalable, transactional and analytically oriented processing of large database systems. Objective of this module is to provide the student with a substantial understanding of redundancy-free storage of data and of the correct and preferably efficient processing of concurrent database operations. In particular, this module attempts to familiarize the students with current developments in this field.	
Forms of Courses:	This module consists of one lecture with a scope of 3 SWS and tutorials with a scope of 1 SWS. In the lecture, the theoretical fundamentals will be taught. The tutorials consist of solving several exercise problems in order to deepen the knowledge of the lectures' contents through collective research into specialized literature. The instructor in charge shall announce the title of the lecture to the students in due time.	
Prerequisites for Participation:	Basic knowledge in the fields of computer architecture, operating systems, and software engineering.	
Usability of this Module:	Free combination with any other module of the program is possible. The courses offered in this module are also used in the same form in the Diploma Programs „Computer Science“, Multimedia Computer Science“ and „Information System Technology“.	
Requirements for Acquiring Credits:	Successful participation in the final module examination.	
Credit Points and Grades:	6 credit points can be acquired for this module. The module grade will be determined by a final oral module examination with a duration of 20 to 30 minutes.	
Frequency of Module Offerings:	This module is offered every academic year.	
Expected Work Load:	The expected workload is 180 work hours (attendance at lectures and tutorials, preparation and reviewing, and examination preparation).	
Duration of Module:	Course spans one semester.	