Regulations for the Course of Studies
M.Sc. Distributed Software
Systems

Implementation provisions
with Annexes
I: Schedule on Studies and Examinations
II: Competence Descriptions
III: Module Manual (*only published electronically*)

TECHNISCHE
UNIVERSITÄT
DARMSTADT

Approval of the Faculty Council on 18-07-2014

Signature of the Dean on

Enforcement of the regulations on

Articles Supplement No.:

0. Table of Contents of the Regulations

1. Implementation Provisions

ad § 2 (1): Academic Degree

The course of studies Master of Science (M.Sc.) "Distributed Software Systems" is supported by the Department of Computer Science of the Technische Universität Darmstadt. The Technische Universität Darmstadt awards the academic degree of Master of Science (M.Sc.) after the total of 120 credit points has been achieved in the course of studies.

ad § 3 (5): Examination Dates

The dates of examinations (subject examinations and achievements of studies) are specified in Annex I of these Implementation Provisions, the Schedule on Studies and Examinations,

ad § 5 (4), (5): Modules, Component Parts and Kind of Examination

In Annex I of these Implementation Provisions, the Schedule on Studies and Examinations, and in Annex III, the Module Manual, the kind of examination achievements (oral, written, special form, thesis, etc.) are specified.

ad § 11 (4), (5): General Admission Requirements - Language Knowledge

The teaching language of the course of studies is English. In the course of studies individual courses are, however, also provided in the German language.

ad § 17a: Entrance Requirements for Master's Courses of Study

1. The entrance requirement for a master's course of study is a bachelor's degree in the field of "Computer Science" at the TU Darmstadt (reference course of study) or a course of study that essentially provides the same competences (comparable course of study). The relevant competences are stated in Annex II of these Implementation Provisions, the Competence Descriptions. These requirements are examined within the scope of an entrance examination.

2. The entrance examination consists of a formal examination of the written documents to be submitted within the scope of registration and if necessary of a substantive examination.

3. If the examination of the written documents indicates a deficit in competences in the extent of which a review shall require achievements in the extent of more than 30 CP, admission to the course of studies shall not be granted. The applicant shall be informed on the missing competences and the module to be absolved to acquire the missing competences.

4. If during examination of written documents doubts regarding the necessary competences should arise, they shall be examined within the scope of a further substantive entrance examination. This examination shall be carried out in the form of a 90-minute written examination or an oral examination lasting 20 to 30 minutes. The examination commission shall determine the form and time of the substantive entrance examination and name an examiner. The examiner shall determine the contents of the examination with the objective to determine the capability of the applicant of the course of studies of Master of Science (M.Sc.) Distributed Software Systems at the Technische Universität Darmstadt. The entrance examination shall be carried out in the presence of an observer.

5. The examiner shall decide on the basis of the entrance examination whether the applicant has the competences required analogous to No. 4 and pursuant to the General Examination Provisions, § 17a Abs. 4 APB, whether the applicant has the required knowledge for the master's course of studies or whether she or he, if applicable, is admitted under certain conditions or admission shall be rejected due to lack of knowledge. The entrance examination cannot be repeated within the same approval period.

6. The admission can be connected to conditions which shall enable the applicant to prove knowledge missing from the bachelor's course of studies or catch up during a period of time to be determined during the master's course of studies at the TU Darmstadt. The conditions must be listed in the notification for admission and met within two semesters. Conditions can be met in two ways: 1. The applicant proves that the required competences have already been acquired through achievements in university studies. 2. The applicant proves that he or she has the required competences by successfully passing course examinations in the field subject to the conditions. If the requirements are not met, the decision connected with admission shall be revoked.

7. The examination commission can exempt an applicant from the substantive entrance examination if due to an admissions and aptitude test of another university or a private organisation with corresponding standards (e.g. GRE or comparable tests), it can be expected that he or she will successfully absolve the master's course of studies.

8. The substantive entrance examination is not an independent examination decision: it is an integrated part of the decision on admission.

9. An entrance requirement is also knowledge of the English language at Stage C1 of the European Framework of Reference or equivalent. The decision shall be made by the examination commission.

ad § 18 (1): Entrance Requirements

The recommended entrance requirements for modules are specified in Annex III of these Implementation Provisions, the Module Manual, in Section "Requirements for Attendance" in the module description of a module.

ad § 22 (2), (3): Conducting Examinations

The duration of written and oral examination shall be specified in the Schedule on Studies and Examinations (Annex I) and the Module Manual (Annex III).

ad § 23 (5): Thesis - Processing Period

The thesis must be written and submitted within 26 weeks. It shall involve work comprising 900 hours.

ad § 25 (3): Formation and Evaluation of Grades

Annex III, the Module Descriptions, specify the evaluation of the grades of the course examinations and the study achievements for each of the module grades. Unless otherwise determined, the grades of the course achievements of the module parts correspond with the credit points referring to the achievements.

The thesis is concluded with a colloquium open to the members of the university. The evaluation of the colloquium is carried out by the examiner and comprises 15 % of the final grade of the master's thesis.

ad § 27 (5): Passing and Not Passing - Elective Areas

The examination achievements to be passed in the elective areas are specified in Annex I of these Implementation Provisions, the Schedule on Studies and Examinations.

ad § 28 (3): Total Grade

Annex I of these Implementation Provisions, the Schedule on Studies and Examinations, specify the evaluation of the module grade in the final grade. Unless otherwise determined, the module grades are included in the total grade in accordance with the credit points acquired in the modules.

ad § 30 (1), (2): Repeating the Examination

Upon submission of an application an elective module may be changed once for an important reason. In this case the repetition examinations required pursuant to § 30 Section 1 Line 1 are not applicable. The change must be approved by the examination commission.[1] Reasons for a rejection must be provided in writing.

ad § 31 (1): Second Repetition

For written examinations the second repletion of the examination may also be carried out orally if the examiner and the examination candidate both agree.

ad § 35 (1): Examination Certificate

The certificate on passing the master's examination shall in addition to the examinations state the module grades of each of the acquired credit points.

ad § 36 (2): Enforcement

These Implementation Provisions shall become effective on 1 October 2015. They shall be published in the Articles Supplement of the Technische Universität Darmstadt. Upon enforcement of these Implementation Provisions the Implementation Provisions dated 08-07-2011 (Articles Supplement x.xx) shall become ineffective. Courses of studies already commenced may upon submitting an application be completed in accordance with the previous Implementation Provision, the application shall be submitted to the student office in charge within one year after enforcement of these Implementation Provisions.[2]

Annex I   Schedule on Studies and Examinations
Annex II   Competence Descriptions
Annex III   Module Manual

Darmstadt, this

The Dean of the Department of Computer Science
of the Technische Universität Darmstadt

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[1] Can be deleted in the event of a corresponding provision in the 5th edition of APB. In the event of a corresponding provision in the 5th edition of APB several modules from the computer science electives can also be changed several times.

[2] In the event that the provision in the 5th edition of APB allows, the application for (PO) change in the Implementation Provisions at hand shall in turn be submitted to student office in charge within one year after enforcement of these Implementation Provisions.

1.1. Annex I: Schedule on Studies and Examinations

Link to the Excel file "Schedule on Studies and Examinations"

1.2. Annex II: Competence Descriptions

1.2.1. Entrance Competences

1.2.1.1 Competences required for the Master of Science Course of Studies in Distributed Software Systems

The following are not the only competences which are acquired in the Bachelor of Science course of studies in Computer Science at the TU Darmstadt. They are, however, characteristic for the requirements of the course of studies and are also essential requirements for continuing studies in one of the cumulative master's course of studies. Each graduate of this course of studies has - in addition to acquiring other competences - made the following experiences:

1. Graduates carried out intensive and comprehensive exercises in the most extensive method of independent processing of problem tasks on all contents of mandatory events of the course of studies. Whereby the definition of

- *intensive and comprehensive* is that these experiences were not only acquired on time (for example in the teaching events arranged for this purpose alone), but also that this is followed up during the entire studies, although not necessarily in each teaching event to the same degree.

- *independent* is that the support offered essentially serves to clarify the task and provide first initial aid, moreover, the student has to handle the task - depending on the requirements - on his or her own or in a team, but independently.

  The problem tasks are often transfer tasks and require creativity and abstraction in solving. The level can be described more exactly as follows:

- *Mathematics*: the ability to understand typical evidence from the proof-oriented studies in mathematics and also to demonstrate this himself or herself correctly in the elementary cases analogous to the lecture. The corresponding competences are also acquired in the courses *Mathematics 1, 2, 3 for Computer Scientists*.

- *Theoretical Computer Science*: the ability to apply mathematical notations and methods to provide well-founded concepts of computer science especially on formal modelling and verification of soft and hardware systems. Courses in which these competences are acquired are also *Propositional and First-Order Logic; Automata, Formal Languages and Decidability; Formal Methods in Software Design; Modelling, Specification and Semantics*.

- *Practical Computer Science*: the ability to

  o independently select the solution of required standard algorithms and data structures according to the functional and non-functional requirements from a description of the problem and on the basis of known strategies designing and estimating new algorithms and data structures to solve the problem, if necessary with consideration to parallelism,

- o independently without analogous examples connect the individual parts of a programming language which are introduced into the lectures separately one after the other to reach an overall solution within the scope of a programming task,

- o solve programming tasks in different, also parallel, programming languages, which follow different paradigms, have different areas of application and are found on different abstraction levels,

- o ensure the quality of implementations using formalised test procedures and design methods,

- o apply this knowledge in practical relevant areas of computer science, like networks and distributed systems, visual computing, information management and engineering/robotics, as well as apply knowledge for development of programming tools, whereby even non-functional aspects, especially the safety of the IT systems, shall be taken into consideration.

  These competences are also acquired in the courses *Functional and Object-Oriented Programming Concepts; Algorithms and Data Structures; Introduction to Compiler Construction; Machine-Oriented and Parallel Programming; Bachelor Internship; Information Management; Computational Engineering and Robotics; Computer Networks and Distribution Systems; Computer System Safety; Software Engineering, Visual Computing.*

- *Technical Computer Science*: the ability to

  - o independently combine individual design principles and basic elements of digital control circuits as they are separately introduced in the lectures one after the other, and without an analogous example within the scope of a hardware design task, into one overall solution,

  - o solve designing tasks on various abstraction level and from different areas of application by means of structured designing methods in various description languages and by applying a spectrum of design tools and to evaluate them regarding suitable quality measures,

  - o understand the interaction of computer, processor and micro architectures and making suitable implementation decisions for the system and application software level,

    Courses in which these competences are acquired are also *Digital Technology; Computer Organisation; Operating Systems, Architectures and Design of Computer Systems.*

2. Due to the organisation of the studies graduates are skilled in independently organising work under close framework conditions based on various time scales (up to a range of several semesters).

1.2.1.2 Criteria of the Entrance Examination on the Master of Science Course of Studies in Distributed Software Systems

All experiences described above are significant in successfully absolving the Master of Science Course of Studies *Distributed Software Systems; Computer Science, Internet and Web-Based Systems; IT Security*. Especially significant is that these experiences are collected in connection with the contents of the principle events, in particular in the core subjects of computer science (structured in principal and major mandatory events), on which the selected master's course of studies is based.

In the following the requirements, which are necessary to successfully absolve the Master of Science course of studies in *Distributed Software Systems,* are defined in detail:

1. The above defined experiences for the core subjects of Computer Science must be verified. Concretely contents from the following events must be covered in the scope of at least 60 CP:

    a. Contents of principle mandatory courses: *Functional and Object-oriented Programing Concepts; Algorithms and Data Structures; Digital Technology; Computer Organisation; Machine-Oriented and Parallel Programming; Operating Systems; Introduction to Compiler Construction; Machines, Formal Languages and Decidability;* P*ropositional and First-Order Logic; Formal Methods in Software Design* and

    b. Contents of major mandatory courses: *Architectures and Design of Computer Systems; Computational Engineering and Robotics; Computer Networks and Distribution Systems; Computer System Safety; Information Management; Software Engineering; Modelling Specification and Semantics; Visual Computing.*

    The contents for the major mandatory events as per 1.b. must essentially be covered by *Computer Networks and Distribution Systems; Information Management; Software Engineering.*

2. Under the condition stated under point 1 the following shall apply: If the bachelor's studies of the petitioner convey general experience in the form described above, but do not cover the essential core subjects of computer science contents in the extent sufficient for the Master of Science course of studies *Distributed Software System*, a favourable prognosis for success can only be made and thus admission only be granted if both the final grade as well as the average of individual grades of the lectures/exercises and comparable teaching events in the core area of computer science evaluated with CPs is not worse than 3.0 and each individual grade in this area is better than 4.0.

3. For bachelor studies which do not meet the above defined requirements regarding the type of tasks and the independence of processing, it can be assumed that if examination results in the core subject of computer science are above-average this insufficiency can be balanced by the personal capabilities of the applicant. In this case a favourable prognosis for success can only be made and thus admission only be granted if both the final grade as well as the average of individual grades of the lectures/exercises and comparable teaching events in the core area of computer science evaluated with CPs is 2.0 or better and also no individual grade in the core area of computer science is worse than 3.0.

Experience otherwise gained (especially from professional activities or continued-education courses) shall be taken into consideration in determining aptitude for the Master of Science course of studies *Distributed Software Systems* to the full extent if the above stated experiences concerning both the contents as well as the level of the task and independent processing are in correspondence with and if these competences have been acquired and evaluated regarding the generally common quality assurance standards of universities.

1.2.2. Qualification Results

In the primarily research-oriented Master of Science course of studies *Distributed Software Systems* the students expand their competences in this subject and interdisciplinary skills from a previous bachelor's course of studies. These competences are characteristic for the requirement of the course of studies and an essential condition for subsequent promotion. After absolving the course of studies the graduates are in a position

- to independently handle complex problems and tasks from the area of Distributed Software Systems with scientific methods by taking various solutions into consideration using their improved methodical competence,

- to apply methods of software engineering for the development of large-scale, distributed software systems. Special focus is on modularisation, scalability and performance of distribution systems (key word: cloud computing),

- to apply knowledge from the area of communication network for the integration of linked heterogenic distributed systems (key word: future internet),

- to apply methods of information management aimed at the application in extreme large-scale distributed software systems (key word: big data),

- to implement these competences also in new and unknown situations with incomplete information and thus to think in a system context.

- to solve tasks and problems with high ability for abstraction talking complex dependencies into account,

- to recognise future problems, technologies and scientific developments and to take them into consideration suitably in their activity,

- to communicate the results of these analyses and/or the elaborated solutions also to professional and non-professional persons

- to organise and carry out complex projects efficiently as well as to form and supervise goal-oriented teams,

- to evaluate and take the social and ethic responsibility of their activity into consideration properly,

- to undergo further education on subjects of the profession on their own and to work scientifically and independently to a great extent.

In summary the master's course of studies differs from the preceding bachelor's course of studies above all in that the focus is on solving complex problems with incomplete information, which require greater ability of

abstraction and thinking in system contexts. Additionally, the capability of being able to evaluate current research literature as well the ability to work scientifically in a self-selected major and to independently solve current problem in practice shall be increased.

1.3. Annex III: Module Manual

The Module Manual shall be electronically published pursuant to § 1 Section (1) of the *Articles of the Technische Universität Darmstadt on the regulations for publication of* the *Articles of the Technische Universität Darmstadt* dated 18 March 2010.