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**Examination Regulations for the  
Master's Degree Program Computer Engineering  
of the Faculty for Electrical Engineering, Computer Science and  
Mathematics  
at the University of Paderborn**

Of June 16<sup>th</sup> 2017

Examination regulations for the master's degree program Computer Engineering of the Faculty for Electrical Engineering, Computer Science and Mathematics at the University of Paderborn

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Based on § 2(4) and § 64(1) of the Law of the Universities of the State North-Rhine Westphalia (Higher Education Act - HEA) of September 16<sup>th</sup> 2014 (GV.NRW. p. 547), last changed by the law of December 15<sup>th</sup> 2016 (GV.NRW. p. 1154), the University of Paderborn has issued the following examination regulations:

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## **§ 1 Purpose of the examinations, aim and duration of studies**

- (1) The master's examination provides a second professional university degree of the studies of Computer Engineering.
- (2) The master's examination shall determine whether the students have extended the knowledge acquired in a previous bachelor's program which is necessary for a professional career in Computer Engineering. It shall further determine whether the students have deepened their knowledge in selected areas, so that they have the ability to use appropriate scientific methods for solving problems in Computer Engineering and to further develop them in their chosen field of academic specialization. The professional requirements in Computer Engineering also comprise the ability of communicating in English language in oral and in written form.
- (3) In addition to the general goals according to § 58 HG, the study program enables the students to use and further develop scientific methods of Computer Engineering in their work, and to act responsibly concerning the effects of technological change,

## **§ 2 Academic degree**

When the master's degree program is completed successfully, the Faculty for Electrical Engineering, Computer Science and Mathematics awards the academic degree "Master of Science", abbreviated "M.Sc.". If, according to § 10 (7), examination performances have been completed in English language in a sufficient scope, the degree "Master's Degree Program Computer Engineering in English Language" will be attested on the certificate.

## **§ 3 Beginning of studies**

The beginning of studies is in the winter term or summer term.

## **§ 4 Admission requirements**

- (1) Admission to the master's program Computer Engineering is granted only to a candidate who cumulatively
  1. Has a certificate of higher education entrance qualification ("Hochschulreife", general or related to a subject), or an advanced technical college certificate according to a legislative decree, or an educational qualification approved as equal by a legal regulation or by the responsible public authority, or fulfills the requirements of qualification by vocational training, or fulfills the requirements of the regulation of university access for foreign nationals ("Bildungsausländerhochschulzugangsverordnung").
  2. Has a qualification which fulfills the following requirements:
    - a) It must involve a first higher education degree qualifying for entering a profession with a prescribed period of study ("Regelstudienzeit") of at least six semesters at the University of Paderborn or a state or state-approved university or a state or state-approved university of cooperative education. Qualifications of a foreign state or state-approved university ensure access, as long as, regarding the gained competences, there is no significant difference to a qualification of the University of Paderborn according to sentence 1.

For foreign educational attainments equivalency agreements approved by the Standing Conference of the State Ministers of Education and the Arts in the Federal Republic of Germany and the Conference of Presidents and Rectors of Universities and Other Higher Education Institutions or corresponding legal regulations have to be taken into account. As far as agreements of the Federal Republic of Germany made with other states about the equivalency in the higher education sector (equivalence treaty) favor students from foreign states differing from sentence 2, regulations of the equivalence treaty come first. Apart from that, in case of doubts about presence or absence of significant differences the central office for foreign education has to be consulted. The examination board is responsible for checking the requirements according to sentence 2.

- b) The qualification has to be gained in the bachelor's degree program Computer Engineering at the University of Paderborn or it must be a qualification, which includes at least the following achievements:
- 20 CP in the field of Mathematics
  - 30 CP in the field of Computer Science, whereby especially topics of Computer Engineering must be covered
  - 30 CP in the field of Electrical Engineering
  - 12 CP for an independent thesis

If 30 credit points are missing from the fields Mathematics and Computer Science, then enrollment can take place under the condition that the requirements are caught up on by adequate studies comprising up to three pre-master courses and approved by passing the corresponding examinations. The examination board is responsible for checking the requirements. The examinations have to be taken within the first two semesters of the master's degree program. These have to be proven at the registration for the master's thesis. A list of possible pre-master courses can be found in appendix C.

3. Has sufficient language skills according to subsections 2 and 3.
4. Attests his or her ability to study by the results of a GRE Revised General Test as a foreign prospective student without equivalent legal status to German citizens. Usually at least 157 points are required in the part "Quantitative Reasoning", at least 4.0 points in the part "Analytical Writing" of the GRE Revised General Test. If there is an excellent grade in the qualification according to No. 2, the examination board can accept a lower number of points, depending on the qualification. Prospective students with a German university entrance qualification are exempted from the evidence of the ability to study.

(2) Admission to the master's program Computer Engineering is granted to a candidate who

1. Has language skills in English which can be proven through transcripts or documents of
  - (a) A successfully completed school instruction in English language from grade 5 and a duration of at least 5 years – as a candidate who obtained the university entrance qualification in Germany ("Bildungsinländer") – or
  - (b) A language test at least on the level TOEFL 500 (paper and pencil) or TOEFL 61 (Internet based) or
  - (c) Equivalent skills (e.g. Cambridge First Certificate (FCE) grade B or IELTS with a minimum result 5.0)
2. Has sufficient skills in German language as a student who has acquired his or her entry qualification not at a German institution. An evidence of the ability to study in German language is needed for unrestricted admission to or enrollment in all study programs. Details are governed by the Regulations for the German Language Examination for University Entry at the University of Paderborn in the respective current version.

- (3) Alternatively to subsection 2 admission is also granted to a candidate who does not have the necessary German language skills, but has profound English language skills instead, which can be proven by certificates or documents of
1. A bachelor's degree obtained in an English speaking foreign country<sup>1</sup> or in an English-taught, accredited, national degree program, or
  2. A Test of English as Foreign Language (TOEFL) "Internet-based" Test (iBT) with a result of at least 80 points, or
  3. A TOEFL "Paper-based" test (PBT) with a result of at least 550 points, or
  4. An IELTS-test with a result of at least 6.5, or
  5. A Cambridge Test – Certificate in Advanced English (CAE) grade B or tests on an equivalent level.
- (4) Enrollment is to be declined, if
1. The conditions mentioned in subsections 1 - 3 are not fulfilled, or if
  2. The candidate has finally failed an examination which is mandatory according to the examination regulations in the desired degree program at a university within the area of application of the German Basic Law, or
  3. The candidate has finally failed an examination which is mandatory according to the examination regulations in another degree program at a university within the area of application of the German Basic Law, if the unsuccessful degree program has a substantial content-related similarity to the master's degree program Computer Engineering at the University of Paderborn. The examination board decides about the substantial content-related similarity.

## **§ 5 Prescribed period of study and extent of studies**

- (1) The prescribed period of study for the master's degree program is four semesters including the master's examination. Students are assumed to have a workload of around 3 600 hours, equivalent to 120 credit points (CP).
- (2) Studies cover modules with an overall scope of 120 credit points, which include mandatory modules with a scope of 24 credit points, elective modules with a scope of 42 credit points, a module Scientific Work Style with a scope of 6 credit points, a two-semester project with a scope of 18 credit points, and the module Thesis with a scope of 30 credit points.
- (3) Credit points are awarded according to the European Credit Transfer System (ECTS). A credit point corresponds to a workload of 30 hours on average. A semester usually includes 30 CP and consequently a workload of 900 hours.
- (4) The Faculty for Electrical Engineering, Computer Science and Mathematics has created an exemplary schedule and a module handbook on the basis of these examination regulations. These documents describe in detail the aims and contents of the modules, assigned courses, as well as recommended prior knowledge. The exemplary schedule and the list of modules can be found in this examination regulation in the appendix A, B and C. The module handbook informs about the status at the time of the resolution on the examination regulations. The module handbook is

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<sup>1</sup> Within the framework of these regulations these are Australia, Great Britain, Ireland, Canada, New Zealand and the United States of America.

updated on a regular basis and published on the websites of the Faculty for Electrical Engineering, Computer Science and Mathematics.

- (5) Course contents described in the module handbook are chosen and limited in a way, that students can complete their studies in the prescribed period of study.
- (6) If the master's degree program Computer Engineering is studied completely in English language, a small restriction in the freedom of choice has to be taken into account. The same applies, if only the required amount of courses mentioned in § 10 (7) are chosen in English.

## **§ 6 Modules**

- (1) The master's degree program Computer Engineering is offered in a modular form. Modules are thematically and temporally independent, self-contained units of qualification, which are equipped with credit points and can be examined. Modules have a scope of 6 - 18 CP (without the module Thesis). In general, they can be completed within one to two semesters.
- (2) Besides the modules Project Group (18 CP) and Thesis (30 CP), the master's degree program consists of mandatory modules (24 CP), elective modules (42 CP) as well as a module called Scientific Work Style (6 CP). The elective modules are assigned to six focus areas for which corresponding module catalogues are listed in the module handbook; the examination board is responsible for the development of these focus areas. Elective modules with a scope of 24 credit points must be chosen from one of the six focus areas (focus of studies); further elective modules with a scope of 18 credit points may be chosen arbitrarily from the six focus areas, so that 42 credit points are reached in total. The module Scientific Work Style contains a seminar with a scope of 4 CP as well as one course, which is free to choose, with a scope of 2 CP; details are regulated in appendix B and the module description.
- (3) A module can consist of mandatory and elective courses. If a module contains elective courses, they are chosen from a course catalogue, which is part of the module description.

## **§ 7 Transfer of credits**

- (1) Credits which have been obtained in other degree programs or in degree programs at other state or state-approved higher education institutions, at state or state-approved colleges of cooperative education or in degree programs at foreign state or state-approved higher education institutions are transferred on request, as long as, regarding the gained competences, there is no major difference compared to the achievements which will be replaced. The comparison shall not be schematic, but based on an overall consideration regarding the purpose of transfer, which is the continuation of studies and taking examinations. Subsections 1 and 2 also apply for the transfer of credits obtained in state-accepted distance learning programs or in distance learning units created by the state North-Rhine Westphalia in cooperation with other states and the federal government.
- (2) For the transfer of credits obtained at foreign higher education institutions the equivalence agreements made by the Standing Conference of the State Ministers of Education and the Arts in the Federal Republic of Germany and the Conference of Presidents and Rectors of Universities and Other Higher Education Institutions as well as agreements within the framework of university partnerships have to be taken into account. As far as agreements of the Federal Republic of Germany with other states on equivalences in higher education (equivalence agreements) are in favor of foreign students different from the regulations in subsection 1, the equivalence agreements

have priority. Otherwise, if there are doubts about the presence or absence of significant differences the central office for foreign education can be consulted.

- (3) On request the examination board has to assign a student to a semester on the basis of credit transfer according to subsection 1.
- (4) For those students who are admitted on the basis of an entrance examination according to § 49 (12) HG, knowledge and skills proven in the entrance examination are credited. The assessments in the entrance certificate have to be acknowledged by the examination board.
- (5) Other skills and qualifications can be credited on request by the examination board on the basis of submitted documents, if those skills and qualifications are equivalent in content and level to the achievements to be replaced.
- (6) The examination board is responsible for crediting according to subsections 1 and 5. Before the presence or absence of significant differences or of equivalence is assessed, the responsible experts in the respective domains have to be consulted. A rejection must be justified.
- (7) The applicant has to submit the information needed for crediting (especially knowledge and skills gained through achievements and examination results) in a form determined by the examination board. The examination board has to decide on applications according to subsection 1 within ten weeks the latest after a complete submission of all relevant information.
- (8) The transfer of credits will be labeled in the report. When examination performances are transferred, grades have to be transferred after a conversion, if necessary, and to be taken into the respective grade calculation, as far as the grading systems are comparable. If there is no grade or if the grading systems are not comparable, the note "passed" is added.
- (9) A performance can only be credited once. This also applies to the assessment of other knowledge and qualifications.

## I. Organization of the examinations

### § 8 Examination board

- (1) The faculty council of the Faculty for Electrical Engineering, Computer Science and Mathematics appoints an examination board for the master's degree program Computer Engineering. It is particularly responsible for
  1. The organization of examinations and the supervision of their implementation.
  2. The compliance with the examination regulations and the compliance with the procedural arrangements adopted for implementing the examinations.
  3. Decisions on appeals against decisions made in an assessment procedure.
  4. Writing an annual report for the faculty council on the development of examinations and periods of study.
  5. Other tasks clearly assigned to the examination board by these regulations.

For subject-specific decisions (e.g. transfer of credits) the examination board consults the responsible experts from the respective domains.

- (2) Beyond that the examination board suggests reforms of the examination regulations and reveals the distribution of grades. The chair of the examination board is assigned certain tasks by these



examination regulations. Beyond that the examination board can delegate tasks to the chair which are not of fundamental significance; this does not apply to decisions on appeals and reports to the faculty council. The chair provides the examination board with a report about the decisions made by her or him alone. The examination board and its chair obtain support from the central examination office.

- (3) The examination board consists of representatives of the Institute for Electrical Engineering and Information Technology and the Institute for Computer Science. It consists of the chair, the vice chair and five more members. Based on the proposals of the respective groups the chair, the vice chair, two more members from the group of professors, one member from the group of the academic staff and two members from the group of students are elected by their respective representatives in the faculty council. Accordingly deputies are elected for the members of the examination board except for the chair and the vice chair. The participation of the institutes, chairmanship and terms of office are regulated as follows:
  1. In the group of professors two members and their deputies come from the participating institutes each. No. 2 remains untouched.
  2. The chair is a member of the group of professors, and the chairmanship rotates between the participating institutes from term to term. The vice chair has to be from the other institute.
  3. The academic staff member comes from the institute, which does not provide the chair.
  4. The terms of office of the members from the group of professors and from the group of the academic staff members last two years and go from October 1<sup>st</sup> of the election year until September 30<sup>th</sup> of the second following year. The terms of office of the student members last one year and go from October 1<sup>st</sup> of the election year until September 30<sup>th</sup> of the following year. Re-election is permitted. Regulations concerning the gender equality according to § 11c HG have to be respected.
- (4) The examination board is a public authority in terms of the administrative procedural law.
- (5) The examination board has a quorum, if besides the chair or the vice chair and two more professors at least one more voting member is present. The examination board makes decisions with a simple majority. If there is a tie, then the chair has the casting vote. In case of pedagogical-scientific decisions, especially concerning assessment and crediting of examination performances, the student members of the examination board only have an advisory voice.
- (6) The chair calls in the examination board. The convocation must be made, if at least three members request it.
- (7) The meetings of the examination board are not public. The members of the examination board, their deputies, the examiners and observers are subject to official secrecy. As far as they are not in public service, they are bound to secrecy by the chair of the examination board.
- (8) Members of the examination board have the right to attend examinations.

## **§ 9 Examiners and observers**

- (1) The examination board appoints the examiners and observers. The appointment can be delegated to the chair. All examiners are independent lecturers of courses in which according to the curriculum and the module descriptions examination performances can be achieved. Someone who has taken at least the equivalent master's examination or a comparable examination can be appointed as an observer.
- (2) Examiners are independent in their examining role.

- (3) The candidate can suggest examiners for the master's thesis and for the oral examinations, if several examiners are available. Suggestions of the candidate shall be taken into account, if possible. This does not justify a legal claim.
- (4) The examination board ensures that the candidate can find the names of the examiners in time, usually four, at least two weeks before the date of the particular examination, in the Campus Management System of the University of Paderborn.

## **II. Examinations**

### **§ 10 Aim, extent and style of the master's examination**

The candidate has to prove throughout the master's examination that she or he has acquired the necessary basis for Computer Engineering, a methodical range of means, a systematic orientation, and on this basis a wide spectrum of general scientific knowledge in engineering and computer science.

- (1) The master's examination consists of
  1. Study-related module examinations about the contents of modules with a scope of 66 credit points,
  2. The module Project Group (18 CP)
  3. The module Scientific Work Style (6 CP) and
  4. The module Thesis (30 CP).
- (2) Study-related module examinations about the contents of the following mandatory modules with the indicated credit points have to be taken:
  1. Mandatory Module Computer Science I (6 CP)
  2. Mandatory Module Computer Science II (6 CP)
  3. Mandatory Module Electrical Engineering I (6 CP)
  4. Mandatory Module Electrical Engineering II (6 CP)
- (3) The elective modules are assigned to six focus areas:
  1. Embedded Systems
  2. Nano / Microelectronics
  3. Computer Systems
  4. Communication and Networks
  5. Signal, Image and Speech Processing
  6. Control and Automation
- (4) Elective modules with a scope of 24 credit points must be chosen from one of the focus areas. Furthermore other elective modules with a scope of 18 credit points must be completed, whereby the electives can be arbitrarily chosen from all focus areas. In total 42 credit points must be accomplished.
- (5) The catalogue of the courses of the elective modules as well as more detailed regulations on the type of examinations for the mandatory and the elective modules can be found in the list of modules in appendix B.

- (6) All students must complete modules and the associated examinations with a scope of at least 24 credit points in English language. Within the framework of these regulations this means that lectures and materials are given, or are available, respectively, in English language, and examinations are held in English language.
- (7) The certificate according to § 2 of the university degree “Master’s Degree Program Computer Engineering in English Language” will be awarded, if
  1. The examination according to subsection 1 No. 4 (module Thesis) has been completely done in English language, and
  2. The following modules have been completed in the form described in subsection 7: the modules according to subsection 1 No. 1 to 3, with exception of modules and examinations with a scope of not more than 18 credit points and with the exception of non-English language courses in the module Scientific Work Style.

### **§ 11 Admission to the master’s examination**

- (1) Only those who are enrolled at the University of Paderborn for the master’s degree program Computer Engineering or are registered as visiting student according to § 52 HG can be admitted to examinations in the master’s degree program Computer Engineering.
- (2) Depending on available capacities and on request to the examination board, students of the bachelor’s degree program Computer Engineering, who have gained at least 152 credit points in their bachelor’s degree program in the first section of study, and have registered their bachelor’s thesis, and are expected to fulfill the entry requirements for the master’s degree program Computer Engineering, will be admitted to modules of the master’s degree program Computer Engineering with a scope of 30 credit points for one semester. This regulation can only be applied once. The repetition of a failed master’s examination is only possible after enrollment in the master’s degree program Computer Engineering. Students cannot claim admission to master’s degree program Computer Engineering at a later time.
- (3) The module Thesis can only be started when modules with a scope of 45 credit points have been successfully completed. In case of enrollment with conditions according to § 4, it must be proven in addition that the related examinations (pre-master courses) have been passed.
- (4) The registration of the master’s thesis has to be submitted to the examination board in written form via the central examination office. An evidence of the entry requirements mentioned in subsection 3 has to be added to the registration.
- (5) Admission is to be declined, if the conditions named in subsections 1 and 3 are not fulfilled.

### **§ 12 Registration and examination deadlines**

- (1) For each module a registration at the Campus Management System of the University of Paderborn is necessary. The registration can only be done, if the admission requirements are fulfilled.
- (2) For each examination a separate registration in the Campus Management System of the University of Paderborn is necessary. The registration is made within the time period announced by the Campus Management System. Examinations can be taken as soon as the achievements needed for admission are proven.

### **§ 13 Completion of a module**

- (1) Every module is completed by a module examination and possibly required qualified participations. The module examination takes place in temporal relation with the module. A module examination usually consists of an examination at the end of the module ("Modulabschlussprüfung"). The module examination can also consist of several partial examinations ("Modulteilprüfungen"). If a module consists of several partial examinations, every partial examination has to be passed. The grade of the module equals the grade reached in the module examination.
- (2) Credit points can only be gained, if the module has been successfully completed. The module is successfully completed, if the examination at the end of a module has been at least graded as "sufficient" and the possibly required qualified participations have been accomplished.

### **§ 14 Examination performances in modules**

- (1) In modules examination performances are rendered according to the module descriptions. The grades of the module examinations contribute to the final grade of the master's examination. They are weighted according to the acquired credit points except for the module Project Group and the module Thesis (cf. § 19).
- (2) If the module descriptions contain overall guidelines about the form and / or duration / scope of the examination performances, the examination board decides in consultation with the examiners how the examination performances have to be rendered in detail. In the third week after beginning of the term the latest, it will be announced in all courses by the lecturers how the examination performances have to be rendered. This applies in the same way to the proof of qualified participations and course works. The examination performances refer to the contents and competences of the related courses.
- (3) All examinations are taken along with the studies. The examinations usually take place two times within an academic year.

### **§ 15 Forms of examination performances in modules, course work and qualified participation**

- (1) Examination performances can be rendered in form of written examinations, oral examinations, written term papers or in other forms. The detailed description of each of the examination performances can be found in appendix B and the module descriptions. The students have to be informed about the results, except for oral exams, via the Campus Management System of the University of Paderborn after six weeks the latest after the achieved performance.
- (2) The following examination performances are defined:
  1. *Written examinations:*

In written examinations the candidate has to demonstrate that she or he is capable of recognizing problems of the subject with the help of the tools allowed by the examiner and solve them with the common methods within the given time frame. A list of the allowed aids has to be announced together with the date of the examination.

Every written examination is graded by one examiner. In case of the last repetition, the assessment is conducted by two examiners.

The duration of a sit-down examination depends on the sum of the credit points in a module. It takes 90 to 120 minutes in case of up to 5 credit points and 120 to 180 minutes in case of more than 5 credit points.

2. *Oral examinations:*

In oral examinations the candidate has to demonstrate that she or he recognizes the interrelations within the examined area, is able to put specific questions into context and find solutions within the time given.

Oral examinations are performed in front of two examiners or one examiner in presence of one competent observer as group examinations or as single examinations. In any case it must be possible to differentiate and grade the contribution counted as an examination performance of each candidate separately. Before setting a grade the examiner consults the observer in absence of the candidate. In case of the last repetition, two examiners do the grading.

The duration of an oral examination per candidate depends on the sum of the credit points of the underlying courses. It takes 20 to 30 minutes in case of up to 5 credit points and 30 to 45 minutes in case of more than 5 credit points. For group examinations the total duration of the examination extends accordingly. The essential content and results of the examination have to be recorded in the minutes of the examination. The result of the examination has to be announced to the candidate subsequent to the oral examination by the examiner.

Students who want to take the same examination at a later examination date will be admitted as listeners according to the spatial conditions, as long as no candidate disagrees. Admission does not extend to the consultation and announcement of the examination result.

3. A *presentation* is a performance of about 30 minutes on the basis of a written composition. Thereby students have to prove that they are able to elaborate a topic scientifically and can present results.
  4. Within the framework of a *written term paper* with a scope of ten DIN-A4 pages a task is dealt with and solved properly within a thematic area of a course with the help of relevant literature, if necessary. The performance can also be made as a group performance, as long as an individual assessment and evaluation of each group member is possible.
  5. In a *colloquium* students have to prove that they can recognize technical interrelations and are able to put specific questions into a context in a conversation of 20 to 30 minutes with the examiner and other participants of the colloquium.
  6. In a *project* the students work on a topic given by the lecturer by themselves or in a group. Projects usually include a draft and structure of hardware and software prototypes, as well as an ensuing experimental evaluation. Other parts of a project are usually the technical documentation and the presentation of the work and its results.
- (3) A *qualified participation* is given, if the achieved performances indicate that the subjects underlying a given problem have been dealt with more than just superficially. The evidence of a qualified participation can be requested in a module, if this is necessary for ensuring the acquisition of competences in the module besides the module examination. The evidence of a qualified participation in a module can be a requirement for the allocation of credit points or a requirement for the participation in examinations. The evidence of a qualified participation is provided especially by
- One or more short written examinations
  - An expert discussion
  - The preparation of a protocol
  - Exercises prepared during the course or as homework

- Short tests ("Testate")
  - A presentation
- (4) As a course work exercises can be requested which usually are put as homework and / or presence tasks on a weekly basis.

## **§ 16 Assessment of examination performances and grades**

- (1) Grades for individual examination performances are determined by the respective examiners. Examination performances have to be graded with the following grades:
- 1 = very good: an excellent performance
  - 2 = good: a performance, which lies significantly above the average requirements
  - 3 = satisfactory: a performance, which corresponds to average requirements
  - 4 = sufficient: a performance, which meets the requirements despite its deficiencies
  - 5 = fail: a performance, which does not meet the requirements due to its significant deficiencies
- (2) For a differentiated assessment intermediate values can be determined by lowering or rising the individual grades by 0.3. Thereby the intermediate values 0.7, 4.3, 4.7 and 5.3 are excluded.
- (3) If an examination performance is graded by several examiners, the grade is determined as the arithmetic mean of the individual grades. Apart from that subsection 4 applies accordingly.
- (4) If an overall module grade is composed of several grades, the arithmetic mean has to be weighted by the workload of the related courses. The result has to be cut off after the first decimal place. The grade is:
- At an average up to and including 1.5 = very good,
  - At an average above 1.5 up to and including 2.5 = good,
  - At an average above 2.5 up to and including 3.5 = satisfactory,
  - At an average above 3.5 up to and including 4.0 = sufficient,
  - At an average above 4.0 up to 5.0 = fail
- (5) Qualified participations have to be proven.
- (6) Course works are graded as "passed" or "not passed".

## **§ 17 Thesis**

- (1) The module Thesis consists of a work plan (qualified participation according to § 15 (3), workload 150 hours) and the master's thesis including an interim presentation and a final presentation (workload 750 hours).
- (2) The master's thesis is an examination which concludes the scientific training and should show that the candidate has the ability to deal with a problem of Computer Engineering according to scientific methods within a given time period. The problem for the thesis has to be defined in such a way that the workload corresponds to 900 hours (30 credit points) in total. The master's thesis usually has a scope of not more than 120 DIN-A4 pages. The interim presentation usually takes 30 to 40 minutes, the final presentation between 45 and 60 minutes. The time limitation for completing the master's thesis is 6 months.

- (3) The master's thesis is offered and supervised by a person with examiner qualification appointed by the examination board according to § 9 (1). The master's thesis is done within the chosen focus of studies according to § 10 (4). The candidate has to be given the opportunity to make suggestions for the topic of the master's thesis. The suggestions do not justify a legal claim.
- (4) On request the chair of the examination board ensures that a candidate receives a topic for the master's thesis in time. The topic is assigned immediately after the acceptance of the work plan by the chair of the examination board. The date of the assignment of the topic has to be recorded by the central examination office.
- (5) The master's thesis can also be permitted in form of a group work, if the contribution of every candidate, which will be judged as an examination performance, can be clearly differentiated on the basis of indications about paragraphs, number of pages or other objective criteria which allow a clear delimitation and assessment and meet the requirements according to subsection 2.
- (6) The topic and task of the master's thesis are communicated to the candidate in written form. The topic can be given back only once and within the first two weeks after the assignment. The time limitation begins again with the assignment of the new topic. On a case-by-case basis the examination board can extend the time limitation for the master's thesis on a justified request of the candidate by at most six weeks, if the reasons are related to the topic of the master's thesis and the responsible supervisor supports it.
- (7) In case of illness while working on the thesis, the deadline for submission of the master's thesis can be extended by at most four weeks on request of the candidate. In addition a medical certificate has to be handed in immediately. A medical certificate attesting the inability to take an examination is sufficient. In case of sufficient actual indications which suggest that the ability of taking an examination is given with a high probability or that a different proof is appropriate, a medical certificate by a medical officer or by a medical officer of the University of Paderborn can be requested at the expense of the University of Paderborn. If the examination board accepts the request, it will inform the candidate in written form. The extension equals the duration of the illness; it does not entail an extension of the prescribed period of study. If the duration of the illness exceeds four weeks, then the candidate may choose a deadline extension of four weeks or apply for a new topic. If the examination board rejects the application, it will inform the candidate in written form as well.
- (8) It is not permitted that the master's thesis has been made for a different examination in the same or in another degree program, not even in part.
- (9) When submitting the master's thesis the candidate has to assure in written form that she or he has written the paper – in case of a group work the relevant part of the paper – independently and has not used any other sources than those indicated as aid and has to indicate citations as well.
- (10) Not later than four weeks after the assignment of the topic the candidate presents the approach and the schedule for the master's thesis in an interim presentation. Not later than four weeks after submitting the master's thesis the final presentation about the topic of the master's thesis and its results is held.

### **§ 18 Acceptance of the master's thesis and assessment of the module Thesis**

- (1) The assessment of the module Thesis is made according to § 16. The grade of the master's thesis is at the same time the grade of the module Thesis. For the completion of the module and for the award of credit points the proof of a qualified participation in form of a work plan is required. The first examiner approves the qualified participation according to § 16 (5).

- (2) The master's thesis has to be submitted to the examination board in due time in two copies (typewritten, bound and paginated), additionally once in electronic form on a physical medium. The date of submission has to be documented by the examination board. In case of submitting the thesis by post, the date of delivery at the post office (postmark) is decisive. If the master's thesis is not submitted in due time, it is considered as graded with "fail" (5.0).
- (3) The master's thesis including the interim and final presentation has to be reviewed and graded by two examiners according to § 12. Besides the first examiner according to §17 (3) the examination board chooses the second examiner. The grade for the thesis is determined as the arithmetic mean of the individual grades, if the difference is smaller than 2.0 and each of the individual grades is at least "sufficient". §16 (4) (3, 4) apply accordingly. If the difference is 2.0 or more or one assessment is "fail" but the other one at least "sufficient", the examination board chooses a third examiner for the assessment of the master's thesis (without the final presentation). In this case the grade is determined as the arithmetic mean of the two better grades. The thesis can only be assessed "sufficient" or better, if at least two grades are "sufficient" or better. §16 (4) (3, 4) apply accordingly.
- (4) The master's thesis is passed, if the grade is at least a "sufficient" (4.0). The assessment of the master's thesis has to be told to the students six weeks after submission of the thesis at the latest.

### **§ 19 Assessment of the Master's thesis and final grade**

- (1) The master's examination is passed, if all of the module examinations according to § 10 including the module Thesis are assessed at least with the grade "sufficient".
- (2) The overall grade is determined as the weighted arithmetic mean of the module grades. All modules except the module Project Group and the module Thesis obtain their credit points as weights. The module Project Group is weighted with the factor  $\frac{1}{2}$ , and the module Thesis is weighted with the factor 2. Additional performances according to § 23 do not contribute to the overall grade.

For the calculation of the result only the first decimal place is taken into account, all the other digits are cut off without rounding. The grade is:

- At an average up to and including 1.5 = very good,
- At an average above 1.5 up to and including 2.5 = good,
- At an average above 2.5 up to and including 3.5 = satisfactory,
- At an average above 3.5 up to and including 4.0 = sufficient,
- At an average above 4.0 up to 5.0 = fail.

- (3) The overall assessment "passed with distinction" is given, if the grade of the thesis module is 1.0, the average of the module grades weighted by the credit points is at least 1.3 and none of the module grades is worse than "good".

### **§ 20 Repetition of examinations, compensation**

- (1) A passed examination cannot be repeated. Paragraph 13 remains unaffected.
- (2) A failed examination can be repeated twice. In case of a sit-down examination the second resit will be replaced by an oral substitute test over the entire grading scale (§ 16, (1 - 2)). § 15 (2) (2) applies accordingly.



- (3) A passed examination of an elective module, which is registered as an additional achievement according to § 23, can be exchanged for a passed or not yet passed or finally failed examination according to § 23 (2) (compensation). Compensation is possible in the chosen focus of studies for two modules within the focus area and for two arbitrary courses within the remaining elective area.
- (4) A module examination is passed, if it has been assessed with at least a “sufficient”. A module examination is finally failed, if the final module examination or a partial module examination cannot be repeated or compensated.
- (5) The module Thesis can be repeated once in case of a “fail” assessment of the master’s thesis. For the repetition a new topic must be assigned. A second repetition is excluded. Returning the topic of the master’s thesis within the time period defined in § 17 (6) (2) is only permitted, if the candidate has not made use of this possibility during the preparation of her or his first master’s thesis.
- (6) For the repetition of the module Thesis the candidate may suggest a different examiner. There is no legal claim.

## **§ 21 Non-attendance, cancelation, cheating, breach of regulations and protective regulations**

- (1) Examinations can be canceled not later than one week before the respective examination date in the Campus Management System of the University of Paderborn without giving reasons.
- (2) An examination performance is assessed “fail” (5.0), if the candidate does not appear on an examination date without valid reasons, or cancels an examination without valid reasons after the examination has started, or cancels an examination after deadline according to subsection 1. The same applies, if a written examination performance is not finished within the given processing time.
- (3) The reasons brought forward for non-attendance or cancelation must be reported in written form and explained to the examination board immediately, but not later than five working days after the respective examination date. In case of an illness of the candidate, a medical certificate attesting the inability to take an examination, dated on the day of the examination at the latest, is sufficient. In case of sufficient actual indications which suggest that the ability of taking an examination is given with a high probability or that a different proof is appropriate, a medical certificate by a medical officer or by a medical officer of the University of Paderborn can be requested at the expense of the University of Paderborn. The illness of the child documented by a medical certificate in terms of § 25 (5) of the Federal Law on Support for Education and Training counts as inability of taking an examination of the candidate, if care could not be guaranteed in a different way, especially in case of a mainly sole care. If the examination board accepts the reasons, the candidate will be informed in written form and a new examination date will be set. In this case already existing examination results have to be taken into account. If the examination board does not accept the reasons, the candidate will be informed in written form.
- (4) If a candidate cheats or tries to cheat, the respective performance in the examination has to be assessed as “fail” (5,0). If the candidate brings unauthorized aids with her or him, the respective performance in the examination can be assessed as “fail” (5.0). The incidents are recorded by the respective invigilators. The assessment according to subsection 1 or the decision according to subsection 2 will be made by the respective examiner.
- (5) A candidate who disturbs the proper procedure of the examination can be excluded from continuing the examination, usually after a warning by the respective examiner or invigilator; in this case the respective examination performance has to be assessed as “fail” (5.0). The reasons for exclusion have to be recorded.

- (6) In serious cases the examination board can exclude candidates from further examination performances. Acts of deception according to HG § 63 (5) can furthermore be punished with a fine of up to 50 000 € and lead to removal from the register of students (“Exmatrikulation”).
- (7) Within 14 days the candidate can request that the decisions according to subsection 4 or subsection 5 are checked by the examination board. Incriminating decisions of the examination board have to be reported to the candidate immediately in written form, including explanations and information on legal remedies available. Before making a decision, the candidate has to be given the chance for a hearing in accordance with the law.
- (8) Furthermore the examination board regulates the compensation of disadvantages for students with a disability or chronic disease. If a student is unable to achieve performances entirely or partly according to the given modalities due to her or his disability or chronic disease, a compensation of disadvantages has to be granted. A compensation of disadvantages is possible in particular in the form of organizational measures and aid, extension of time limitation or permission of another equivalent form of examination performance. The disability or chronic disease has to be credibly shown. For this a medical certificate or a psychological expertise can be requested. The application has to name and explain the requested modifications. On request of the student or the examination board and in agreement with the student the representative for students with disability or chronic disease can recommend a form of disability compensation.
- (9) Special situations of students with family responsibilities during the course of studies and when rendering performances will be taken account of. This happens inter alia in the following forms:
  1. On request of a candidate protection provisions according to §§ 3, 4, 6 and 8 of the Maternity Protection Act have to be taken into account accordingly. Necessary proofs have to be added to the application. The examination board can determine other forms of examination performances in consideration of an individual case. Maternity protection periods interrupt every time period according to these examination regulations or the special regulations; the duration of the maternity protection will not be counted into the time period.
  2. Also the time periods of parental leave have to be taken into account on request according to the respective valid legislation on parental allowance and parental leave. The candidate has to inform the examination board in written form including all relevant information for which time period or time periods she or he wants to make use of the parental leave not later than four weeks before the point in time from when she or he wants to start the parental leave. The examination board checks whether the legal conditions are fulfilled, which would lead to an employee being entitled to parental leave according to the legislation on parental allowance and parental leave, and sets dates and deadlines under consideration of the individual case. The deadline for the bachelor’s thesis can be only extended to not more than twice the planned processing time. Otherwise the thesis counts as not assigned and the candidate receives a new topic after the expiration of the parental leave.
  3. On request the examination board takes into account inactive periods due to care and education of children in terms of § 25 (5) of the Federal Law on Support for Education and Training, and inactive periods due to care of the spouse, registered partner, partner in a consensual union or a direct relative or a relative related in marriage in first degree, and sets deadlines and dates under consideration of the individual case. Otherwise sentences 4 and 5 from number 2 apply accordingly.

## **§ 22 Completion of studies, final failure**

- (1) Studies are completed successfully, if the master's examination is passed. The master's examination is passed, if all modules of the degree program including the final module are successfully completed.
- (2) The master's examination is finally failed, if a module is finally failed and compensation according to § 20 (3) is not possible.
- (3) The notification about a finally failed master's examination will be issued to the candidate in written form by the examination board. The notification has to be supplied with information on legal remedies available.
- (4) If a candidate has finally failed the master's examination, she or he will receive a transcript on request, which contains the achieved performances and achieved credit points, if necessary, and which indicates that the master's examination has been finally failed.
- (5) Students who leave the university without graduating and for other reasons have to receive a transcript after deregistration which contains the achieved performances and, if necessary, the achieved credit points on application.

## **§ 23 Additional modules**

- (1) Beyond the achievements required in § 10 students can take examinations for modules with a scope of up to 24 credit points. Failed examinations also fall under this upper limit. Regulations for modules with a limited number of participants according to § 59 HG remain unaffected. Grades achieved with additional modules are listed in the "Transcript of Records", unless the student requests their omission until the submission of the thesis. They will not be taken into account for determining the final grade within the master's examination.
- (2) Under consideration of the upper limit indicated in subsection 1 a transfer for the purpose of compensation according to § 20 (3) is possible. Failed examinations fall under the upper limit as well.
- (3) Additional performances have to be indicated as such at the registration.

## **§ 24 Report, Transcript of Records and Diploma Supplement**

- (1) If a candidate has completed the studies successfully, she or he receives a report on the result. This report includes the name of the degree program, prescribed period of study and the overall grade. The report shows the date of the last examination performance. In addition the date of issue is shown. The report is to be signed by the chair of the examination board.
- (2) Furthermore the candidate receives a Transcript of Records in which all rendered examination performances and the duration of professional studies are listed. The Transcript of Records contains information about credit points and achieved grades of the completed modules and the master's thesis. Moreover it contains the topic of the master's thesis and the achieved overall grade of the master's examination.
- (3) Together with the report the graduate receives a Diploma Supplement.
- (4) The Diploma Supplement is an addition to the report in English and German language with uniform information about German university degrees, which explain the German education system and

classify the present degree. The Diploma Supplement informs about the completed degree program and the academic and professional qualifications gained with the degree. The Diploma Supplement contains the essential contents of the degree program, the course of studies, the competences gained with the degree as well as the awarding university.

### **§ 25 Master's degree certificate**

- (1) Along with the report on the passed master's degree the candidate receives a Master's degree certificate with the date of the report. Therein the award of the master's degree is certified according to § 2.
- (2) The Master's degree certificate is signed by the department head of the Faculty for Electrical Engineering, Computer Science and Mathematics and furnished with the seal of the University of Paderborn.
- (3) A translation in English language is added to the Master's degree certificate.

### **§ 26 Inspection of examination files**

- (1) The candidate can be given the chance to access her or his written examination performances and the related assessments of the examiners after the announcement of the grades. The chair of the examination board decides about place and time of the inspection; she or he can delegate these tasks to the examiners. Place and time of the inspection have to be announced during the examination, at the latest during the announcement of the grade.
- (2) If subsection 1 is not applied, the candidate will be allowed on request to access her or his written examination performances, the related assessments of the examiners and the minutes of the examinations, at the latest one month after the announcement of the results of the respective examinations. Within one year after handing over the report the candidate is allowed on request to access the bachelor's thesis, the related reviews of the examiners and the minutes of the examination. The chair of the examination board decides about place and time of the inspection; she or he can delegate these tasks to the examiners.

## **III. Final Regulations**

### **§ 27 Invalidity of the master's examination**

- (1) If a candidate has deceived during an examination and this fact becomes evident only after handing over the report, the examination board can post hoc correct the grades accordingly for those examination performances, during which the candidate has deceived, and announce the examination as entirely or partially failed.
- (2) If the requirements for admission to an examination were not fulfilled, without the candidate's intention to deceive about this, and this fact has become evident after handing out the report, this deficiency will be ignored, if the applicant has passed the exam. If the candidate has deliberately, unlawfully obtained the admission to the examination, the Examination Committee shall decide on the legal consequences taking into account the Administrative Procedure Act for the state of North Rhine-Westphalia.

- (3) Before a decision is made, the affected person has to be given the opportunity of giving a statement.
- (4) The incorrect report has to be confiscated and a new one has to be given, if applicable. A decision according to subsection 1 and subsection 2 is excluded after a time period of five years after issuing the examination report.
- (5) If the overall master's examination has been declared as failed, the master's degree has to be nullified and the Master's degree certificate has to be confiscated. The nullification of the master's degree is only allowed within five years since the date of awarding the degree.

### **§ 28 Nullification of the master's degree**

The master's degree is nullified, if it becomes evident post hoc that it has been acquired by deception or essential requirements have been erroneously considered as given. The faculty council decides on the nullification with two third of its members. The nullification is only allowed within five years since the date of awarding the degree.

### **§ 29 Transition regulations**

- (1) These examination regulations apply for all students who are registered for the master's degree program Computer Engineering of the Faculty for Electrical Engineering, Computer Science and Mathematics at the University of Paderborn for the first time starting from the winter term 2017/18.
- (2) Students who have been registered at the University of Paderborn for the master's degree program Computer Engineering of the Faculty for Electrical Engineering, Computer Science and Mathematics before the winter term 2017/18 can take the master's examination including the resits for the last time in the summer term 2020 according to the examination regulations in the form of May 31<sup>st</sup> 2013 (Am.Uni.PB 43/13), last changed by the statutes from December 11<sup>th</sup> 2015 (Am.Uni.PB 107/15). Starting from the winter term 2020/2021 the master's examination including the resits is taken according to the present examination regulations.
- (3) On request students can switch to the present examination regulations. The switch is irrevocable.

### **§ 30 Entry into force and publication**

- (1) These examination regulations enter into force on October 1<sup>st</sup> 2017. Concurrently the examination regulations of May 31<sup>st</sup> 2013 (Am.Uni.PB 43/13), last changed by the statutes of December 11<sup>th</sup> 2015 (Am.Uni.PB 107/15) cease to be in force. § 29 remains unaffected.
- (2) These examination regulations will be published in the official communications of the University of Paderborn (AM Uni. Pb.).

Issued based on the decision of the faculty council for the Faculty of Electrical Engineering, Computer Science and Mathematics of April 24th 2017 and the legality audit by the Presidential Board of the University of Paderborn of May 24<sup>th</sup> 2017.

Paderborn, June 16<sup>th</sup> 2017

For the President  
The Vice President for Economic  
Administration and Personnel Management  
of the University of Paderborn  
Simone Probst

## Appendix A: Schedule of the Master's Program Computer Engineering

The following illustration shows an exemplary schedule of the master's degree program Computer Engineering with its modules and credit points (CP) per module. For every module the courses are listed, in each case with information about the semester periods per week ("SWS", attendance time) and the workload. Per semester the weekly attendance time in total and the achievable credit points are indicated.

1st Semester 20 SWS / 30 CP	2nd Semester - SWS / 30 CP	3rd Semester - SWS / 30 CP	4th Semester - SWS / 30 CP
Focus Area 24 CP (4 modules from 1 out of 6 focus areas)			Thesis 30 CP
Module 1 e.g. 2+2 SWS / 180 h	Module 2 e.g. 2+2 SWS / 180 h	Module 4 e.g. 2+2 SWS / 180 h	Work Plan - / 150 h
	Module 3 e.g. 2+2 SWS / 180 h		Master's Thesis - / 750 h
Mandatory Module EE I 6 CP	Further Electives 18 CP (3 modules can be selected arbitrarily)		
Statistical Signal Processing* 2+2 SWS / 180 h	Module 1 e.g. 2+2 SWS / 180 h	Module 2 e.g. 2+2 SWS / 180 h	
Mandatory Module EE II 6 CP		Module 3 e.g. 2+2 SWS / 180 h	
Circuit and System Design 2+2 SWS / 180 h	Project Group 18 CP		
Mandatory Module CS I 6 CP	Project Computer Engineering - / 540 h		
Advanced Computer Architecture 2+2 SWS / 180 h	Scientific Work 6 CP		
Mandatory Module CS II 6 CP	Seminar - / 120 h		
Networked Embedded Systems 2+2 SWS / 180 h	Languages, Writing and Presentation Techniques - / 60 h		

### Focus areas:

- Embedded Systems
- Nano / Microelectronics
- Computer Systems
- Communication and Networks
- Signal, Image and Speech Processing
- Control and Automation

### Other electives:

Modules can be chosen from all six focus areas.

### Thesis:

Topic of the master's thesis must be selected from the focus of studies.

## Appendix B: Modules in the Master's Program Computer Engineering

As a result of the further development of the research and teaching content of the institutes for Computer Science and for Electrical Engineering and Information Engineering modules in the elective area of the following list can be omitted in small number or be replaced by modules, which professionally belong to the same area, in small number or complemented. Changes are announced in the module handbook. Regulations of the performances, of the scope as well as the individual course requirements remain unaffected from it.

<b>Module</b> Course (LV)	<b>CP Module</b> SWS LV	<b>Number and form of examinations</b>	<b>Notes</b>
<b>Mandatory module Computer Science I</b>	<b>6</b>	1 oral examination or written examination as final module examination	Mandatory module Requirement for the participation in module examination: course work
Networked Embedded Systems	2+2		
<b>Mandatory module Computer Science II</b>	<b>6</b>	1 oral examination or written examination as final module examination	Mandatory module
Advanced Computer Architecture	2+2		
<b>Mandatory module Electrical Engineering I</b>	<b>6</b>	1 oral examination or written examination as final module examination	Mandatory module; Can be replaced by: Verarbeitung statistischer Signale (in German, 2+2)
Statistical Signal- Processing	2+2		
<b>Mandatory module Electrical Engineering II</b>	<b>6</b>	1 oral examination or written examination as final module examination	Mandatory module
Circuit and System Design	2+2		
<b>Scientific Work Style</b>	<b>6</b>	1 presentation in the seminar	Mandatory module;  The qualified participation according to § 8 (5) in Languages, Writing and Presentation Technology is required for the completion of the module and the award of credit points. Details can be found in the module handbook.
Seminar	4		
Languages, Writing and Presentation Techniques	2		
<b>Elective modules from the focus area</b>	<b>24</b>	Per module 1 oral examination or written examination as final module examination	Requirement for the participation in the module examination in modules from computer science: Course work
Selection from the module catalogue one of six focus areas			
<b>Further elective modules</b>	<b>18</b>	Per module 1 oral examination or written examination as final module examination	Requirement for the participation in the module examination in modules from computer science: Course work
Arbitrary selection out of all module catalogues of the six focus areas			



<b>Module</b> Course (LV)	<b>CP Module</b> SWS LV	<b>Number and form of examinations</b>	<b>Notes</b>
<b>Project Group</b>	<b>18</b>	<b>Project</b>	
<b>Thesis</b>	<b>30</b>	See § 18, § 19	The proof of the qualified participation according to § 8 (5) in form of a work plan is required for the completion of the module and the award of credit points. Admission to the thesis module only after a successful completion of modules with a scope of 45 CP; the master's thesis has to be out of the focus of study.
Work plan			
Master's thesis			

### **Courses in the area “Languages, writing and presentation technology”**

A subject can be selected from the range of courses at the University of Paderborn in the subject areas Foreign Languages, Writing Scientific Texts and Presentation Technology. The range of courses is shown in the course catalogue of the University of Paderborn. The aim of these optional subjects is to ensure enhancement and specialization of interdisciplinary qualifications.

### **List of focus areas with associated modules**

The following focus areas and modules within the focus are listed in alphabetical order.

#### *Focus area “Communication and Networks”*

- Advanced Distributed Algorithms and Data Structures
- Empiric Performance Evaluation
- Foundations of Cryptography
- Future Internet
- Mobile Communication
- Network Simulation
- Optical Communication A
- Optical Communication B
- Optical Communication C
- Optimal and Adaptive Filters
- Routing and Data Management in Networks
- Topics in Signal Processing
- Vehicular Networking
- Wireless Communications

#### *Focus area “Computer Systems”*

- Adaptive Hardware and Systems
- Algorithms and Tools for Test and Diagnosis of Systems on a Chip
- Algorithms for Synthesis and Optimization of Integrated Circuits

- Architecture of Parallel Computer Systems
- Compiler Construction
- Databases and Information Systems
- Empiric Performance Evaluation
- Hardware / Software Codesign
- High-Performance Computing
- Intelligence in Embedded Systems
- Reconfigurable Computing
- VLSI Testing

*Focus "Control and Automation"*

- Advanced Control
- Advanced System Theory
- Advanced Topics in Robotics
- Biomedical Measuring Technologies
- Dynamic Programming and Stochastic Control
- Controlled AC Drives
- Optical Measurement Techniques
- Robotics
- Ultrasonic Measurement Technology
- Environmental Monitoring and Measuring Technologies

*Focus area "Embedded Systems"*

- Adaptive Hardware and Systems
- Advanced VLSI Design
- Algorithms and Tools for Test and Diagnosis of Systems on Chip
- Algorithms for Synthesis and Optimization of Intergrated Circuits
- Architecture of Parallel Computer Systems
- Compiler Construction
- Hardware / Software Codesign
- Intelligence in Embedded Systems
- Model-Driven Software Development
- Network Simulation
- Reconfigurable Computing
- Quickly integrated circuits for the digital communication technology
- Software Quality Assurance
- VLSI Testing
- Vehicular Networking

*Focus area "Nano / Microelectronics"*

- Advanced VLSI Design
- Algorithms and Tools for Test and Diagnosis of Systems on Chip

- Algorithms for Synthesis and Optimization of Integrated Circuits
- Introduction into High Frequency Technology
- Semi-conductor Process Technology
- High Frequency Engineering
- Fast Integrated Circuits for Digital Communication
- Technology of Highly Integrated Circuits
- VLSI Testing

*Focus area "Signal, Image and Speech Processing"*

- Advances System Theory
- Digital Image Processing I
- Digital Image Processing II
- Digital Speech Signal Processing
- Cognitive Sensor Systems
- Statistics in Measurement
- Optimal and Adaptive Filters
- Statistical Learning and Pattern Recognition
- Cognitive Systems Engineering
- Topics in Pattern Recognition and Machine Learning
- Topics in Signal Processing
- Video Technology
- Wireless Communication

**List of all elective modules in alphabetical order**

- Adaptive Hardware and Systems
- Advanced Control
- Advanced Distributed Algorithms and Data Structures
- Advanced System Theory
- Advanced Topics in Robotics
- Advanced VLSI Design
- Algorithms and Tools for Test and Diagnosis of Systems on Chip
- Algorithms for Synthesis and Optimization of integrated Circuits
- Architecture of parallel computer system
- Biomedical Measuring Technologies
- Compiler Construction
- Databases and Information Systems
- Digital Image Processing I
- Digital Image Processing II
- Digital Speech Signal Processing
- Dynamic Programming and Stochastic Control
- Introduction to High-Frequency Engineering I
- Empiric Performance Evaluation

- Foundations of Cryptography
- Future Internet
- Controlled AC Drives
- Semiconductor Device Integration
- Hardware / Software Codesign
- High Frequency Engineering
- High-Performance Computing
- Intelligence in Embedded Systems
- Cognitive Sensor Systems
- Statistics in Measurement
- Mobile Communication
- Model-Driven Software Development
- Network Simulation
- Optical Communication A
- Optical Communication B
- Optical Communication C
- Optimal and Adaptive Filters
- Optical Measurement Techniques
- Reconfigurable Computing
- Robotics
- Routing and Data Management in Networks
- Fast Integrated Circuits for Digital Communication
- Software Quality Assurance
- Statistical Learning and Pattern Recognition
- Cognitive Systems Engineering
- Technology of Highly Integrated Circuits
- Topics in Pattern Recognition and Machine Learning
- Topics in Signal Processing
- Ultrasonic Measurement Technology
- Environmental Monitoring and Measuring Technologies
- Vehicular Networking
- Video Technology
- VLSI Testing
- Wireless Communication

## Appendix C: Pre-Master Courses

In case of admission with conditions according to § 4 (1) (2b) pre-master courses have to be completed, if necessary, before the master's thesis can be registered. The following pre-master courses are possible:

<b>Pre-master course</b>	<b>Scope</b>
<i>Basics Human-Machine-Interaction</i>	2 SWS
<i>Mathematics 1 and 2</i>	4 SWS
<i>Models and Algorithms 1 and 2</i>	4 SWS
<i>Soft Skills, Management</i>	2 SWS
<i>Software Engineering 1 and 2</i>	4 SWS
<i>Systems 1 and 2</i>	4 SWS