Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Core module

Module number	243031-055 (Version 02)
Module name	Design of Digital Systems
Module coordinator	Professorship of Circuit and System Design
Content and qualification objectives	Content: • Design levels and strategies • Processes and abstraction in system design • System specification and HW/SW codesign • Modelling, hardware description languages • Tools for simulation, verification and synthesis Qualification objectives: Students have an overview of design tools, processes and methods for digital systems. They understand the need for design structuring and are familiar with the underlying philosophies, tools and their performance.
Teaching methods	The teaching methods of the module are lecture, exercise class, seminar and practical class. • Lecture: Design of Digital Systems (1 teaching unit) • Exercise class: Design of Digital Systems (1 teaching unit) • Seminar: Design of Digital Systems (1 teaching unit) • Practical class: Design of Digital Systems (1 teaching unit) The classes are held in English.
Requirements for participation (recommended knowledge and skills)	none
Applicability of the module	---
Requirements for the award of credits	Fulfilment of the admission requirement for the assessment component and successful completion of the module examination are prerequisites for the award of credits. The admission requirement is the following examination prerequisite (repeatable without limit): • successfully certified practical class Design of Digital Systems
Module examination	The module examination consists of one assessment component: • 90-minute written examination on Design of Digital Systems (examination number: 42601) The assessment component is to be completed in English.
Credits and grades	5 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year in the winter semester.
Number of hours	The module requires students to complete a total of 150 study hours.
Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Core module

Module number	243031-075 (Version 02)
Module name	Design of Heterogeneous Systems
Module coordinator	Professorship of Circuit and System Design
Content and qualification objectives	Content: • Design process of heterogeneous systems • Modelling, description languages digital/analogue/mixed-signal • System specification • Operating principles of simulators • Mixed-signal coupling problems Qualification objectives: Students understand the necessity and principles of modern design flows using hardware description languages. They have an overview of the specific features of the design of heterogeneous systems, which may consist of components from different physical domains (electrical, mechanical, thermal, etc.). They know various design methods and tools for such systems and have developed an understanding of the underlying philosophies and algorithms.
Teaching methods	The teaching methods of the module are lecture, exercise class, seminar and practical class. • Lecture: Design of Heterogeneous Systems (1 teaching unit) • Exercise class: Design of Heterogeneous Systems (1 teaching unit) • Seminar: Design of Heterogeneous Systems (1 teaching unit) • Practical class: Design of Heterogeneous Systems (1 teaching unit) The classes are held in English.
Requirements for participation (recommended knowledge and skills)	Basic knowledge of a programming language
Applicability of the module	---
Requirements for the award of credits	Fulfilment of the admission requirement for the assessment component and successful completion of the module examination are prerequisites for the award of credits. The admission requirement is the following examination prerequisite (repeatable without limit): • successfully certified practical class Design of Heterogeneous Systems
Module examination	The module examination consists of one assessment component: • 90-minute written examination on Design of Heterogeneous Systems (examination number: 42616) The assessment component is to be completed in English.
Credits and grades	5 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year in the summer semester.
Number of hours	The module requires students to complete a total of 150 study hours.
Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Core module

Module number	243031-085 (Version 02)
Module name	Test of Digital and Mixed-Signal Circuits
Module coordinator	Professorship of Circuit and System Design
Content and qualification objectives	Content: • Fundamentals of testing, types of faults • Test strategies • Generation of digital test patterns • Design for testability • Test hardware and software, test automation • Particularities of mixed-signal testing Qualification objectives: Students have an overview of test methods and strategies and understand the influence of testing on the design process. They know test equipment and programs as well as special methods for automated testing and mixed-signal testing.
Teaching methods	The teaching methods of the module are lecture, exercise class and seminar. • Lecture: Test of Digital and Mixed-Signal Circuits (1 teaching unit) • Exercise class: Test of Digital and Mixed-Signal Circuits (1 teaching unit) • Seminar: Test of Digital and Mixed-Signal Circuits (2 teaching units) The classes are held in English.
Requirements for participation (recommended knowledge and skills)	Basic knowledge of measurement technology and Boolean algebra
Applicability of the module	---
Requirements for the award of credits	Successful completion of the module examination is a prerequisite for the award of credits.
Module examination	The module examination consists of one assessment component: • 120-minute written examination on Test of Digital and Mixed-Signal Circuits (examination number: 42603) The assessment component is to be completed in English.
Credits and grades	5 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year in the winter semester.
Number of hours	The module requires students to complete a total of 150 study hours.
Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Core module

Module number	243031-125 (Version 01)
Module name	Elements of Integrated Circuits
Module coordinator	Professorship of Circuit and System Design
Content and qualification objectives	Content: • Structure of integrated circuits • Basic digital logic structures • Interconnect structures • Input/output circuits • Supply networks • Structures for testability • Mixed-signal circuits • Programmable circuits Qualification objectives: Students know the structure and the components of integrated circuits. They are able to select suitable sub-circuits from various implementation variants. They can combine these sub-circuits into an optimal integrated overall circuit. In doing so, they provide suitable possibilities for testing the integrated circuit.
Teaching methods	The teaching methods of the module are seminar and practical class. • Seminar: Elements of Integrated Circuits (2 teaching units) • Practical class: Elements of Integrated Circuits (2 teaching units) The classes are held in English.
Requirements for participation (recommended knowledge and skills)	Basic knowledge of electronic components and circuits as well as Boolean algebra
Applicability of the module	---
Requirements for the award of credits	Fulfilment of the admission requirement for the assessment component and successful completion of the module examination are prerequisites for the award of credits. The admission requirement is the following examination prerequisite (repeatable without limit): • successfully certified practical class on Elements of Integrated Circuits
Module examination	The module examination consists of one assessment component: • 25-minute oral examination with practical parts (approx. 10 minutes) on the module content (examination number: 42648) The assessment component may be completed in English or in German.
Credits and grades	5 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year in the winter semester.
Number of hours	The module requires students to complete a total of 150 study hours.
Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Core module

Module number	244032-035 (Version 02)
Module name	Technologies for Micro and Nano Systems
Module coordinator	Professorship of Smart Systems Integration
Content and qualification objectives	Content: • Process steps for Si MEMS/NEMS • Process steps for non-Si MEMS/NEMS • Si-based technologies • Technologies for alternative materials • Packaging and 3D integration technologies • Measurement technology for MEMS/NEMS • Examples of Si MEMS • Examples of non-Si MEMS • Examples of nano components and NEMS • Trends and roadmaps Qualification objectives: Students know the technological steps and process sequences for the manufacture of MEMS and NEMS components and systems. They have knowledge of technologies for innovative MEMS (Micro-Electro-Mechanical Systems) and NEMS (Nano-Electro-Mechanical Systems) as well as for system integration.
Teaching methods	The teaching methods of the module are lecture and exercise class. • Lecture: Technologies for Micro and Nano Systems (3 teaching units) • Exercise class: Technologies for Micro and Nano Systems (2 teaching units) The classes are held in English.
Requirements for participation (recommended knowledge and skills)	none
Applicability of the module	---
Requirements for the award of credits	Successful completion of the module examination is a prerequisite for the award of credits.
Module examination	The module examination consists of one assessment component: • 120-minute written examination on Technologies for Micro and Nano Systems (examination number: 42202) The assessment component is to be completed in English.
Credits and grades	6 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year and begins in each case in the winter semester.
Number of hours	The module requires students to complete a total of 180 study hours.
Module duration	Under normal circumstances, the module is completed in two semesters.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Core module

Module number	244034-085 (Version 03)
Module name	Integrated Circuit Design - Transistor Level
Module coordinator	Professorship of Electronic Devices of Micro and Nano Technology
Content and qualification objectives	Content: • Development processes and abstraction levels of IC design • Fundamentals of the integrated digital design flow • Topology for selected technologies (BJT, MOS, CMOS, BiCMOS) • Circuit design and network analysis (MOS technology, dynamic circuit techniques, basic analogue circuits) • Logic design and logic simulation, timing and signal value models (VHDL) • Design guidelines as well as design rules and their application (design rules), design rule checking (DRC) and extraction • Layout and chip design, yield and quality assurance • Scaling and effects on electrical parameters/reliability • Fundamentals of static and dynamic analysis as well as convergence problems • Design for testability and testing: causes of faults and fault models • Development of test bit sequences and test methods, memory test methods Qualification objectives: Students have knowledge of layout and circuit design taking integration and tolerance into account, of circuit testing and of quality assurance. They are able to use corresponding design software in a goal-oriented manner in practice.
Teaching methods	The teaching methods of the module are lecture, exercise class and practical class. • Lecture: Integrated Circuit Design – Transistor Level (2 teaching units) • Exercise class: Integrated Circuit Design – Transistor Level (1 teaching unit) • Practical class: Integrated Circuit Design – Transistor Level (1 teaching unit) The classes are held in English.
Requirements for participation (recommended knowledge and skills)	Basic knowledge of components and circuits (e.g. module Elektronische Bauelemente und Schaltungen)
Applicability of the module	---
Requirements for the award of credits	Fulfilment of the admission requirement for the assessment component and successful completion of the module examination are prerequisites for the award of credits. The admission requirement is the following examination prerequisite (repeatable without limit): • successfully certified practical class Integrated Circuit Design – Transistor Level
Module examination	The module examination consists of one assessment component: • 30-minute oral examination on Integrated Circuit Design – Transistor Level (examination number: 41421) The assessment component is to be completed in English.
Credits and grades	5 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year in the summer semester.
Number of hours	The module requires students to complete a total of 150 study hours.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Core module

Module number	244036-055 (Version 02)
Module name	Reliability of Micro and Nano Systems
Module coordinator	Professorship of Materials and Reliability of Microtechnical Systems
Content and qualification objectives	Content: • Introduction and motivation for reliability • Introduction to materials and manufacturing processes in assembly and interconnection technology • Fundamentals of materials and of their deformation and failure behaviour under thermo-mechanical load • Mathematical description by means of vector analysis • Fundamentals of reliability assessment • Fracture mechanics and crack concepts • Experimental reliability investigations and static evaluation • Failure analysis methods • Application examples for the reliability of micro and nano systems Qualification objectives: Students know the fundamentals of the reliability assessment of components and systems. They are able to apply current calculation methods and to carry out experiments.
Teaching methods	The teaching methods of the module are lecture and exercise class. • Lecture: Reliability of Micro and Nano Systems (4 teaching units) • Exercise class: Reliability of Micro and Nano Systems (2 teaching units) The classes are held in English.
Requirements for participation (recommended knowledge and skills)	none
Applicability of the module	---
Requirements for the award of credits	Successful completion of the module examination is a prerequisite for the award of credits.
Module examination	The module examination consists of one assessment component: • 90-minute written examination on Reliability of Micro and Nano Systems (examination number: 42803) The assessment component is to be completed in English.
Credits and grades	6 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year and begins in each case in the winter semester.
Number of hours	The module requires students to complete a total of 180 study hours.
Module duration	Under normal circumstances, the module is completed in two semesters.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Specialisation module Test and Reliability

Module number	212001-334 (Version 01)
Module name	Modern microscopies
Module coordinator	Dean of Studies Physics of the Faculty of Natural Sciences
Content and qualification objectives	Content: The module conveys a comprehensive overview of analytical microscopy as it is used in many areas of physics, chemistry, electrical engineering and materials science. The fields of application of the methods are demonstrated with current examples. • Imaging methods (TEM, AFM, STM) • Diffraction methods • Spectroscopy of electronic and vibronic states • Excitations Qualification objectives: • Understanding of physical relationships • Skills in physical modelling • Knowledge of and understanding for characteristic approaches • Ability to work independently with specialist scientific literature
Teaching methods	The teaching methods of the module are lecture and exercise class. • Lecture: Modern microscopies (2 teaching units) • Exercise class: Modern microscopies (2 teaching units) The classes are normally held in English.
Requirements for participation (recommended knowledge and skills)	none
Applicability of the module	---
Requirements for the award of credits	Successful completion of the module examination is a prerequisite for the award of credits.
Module examination	The module examination consists of one assessment component: • 120-minute written examination on Modern microscopies (examination number: 11204) The assessment component is to be completed in English.
Credits and grades	5 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is normally offered every academic year in the summer semester.
Number of hours	The module requires students to complete a total of 150 study hours.
Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Specialisation module Test and Reliability

Module number	243031-065 (Version 02)
Module name	Verification of Digital Systems
Module coordinator	Professorship of Circuit and System Design
Content and qualification objectives	Content: • Introduction to formal and informal verification methods • Regression-capable random-driven verification concepts • Assertion-based and coverage-based methods • Binary decision diagrams • Equivalence checking, property checking • Temporal logic and model checking Qualification objectives: Students have an overview of verification techniques for digital circuits and are familiar with the algorithms, concepts and performance of selected verification methods. They can present relevant findings to a specialist audience in the form of a talk and apply their knowledge and skills in practical laboratory experiments.
Teaching methods	The teaching methods of the module are exercise class, seminar and practical class. • Exercise class: Verification of Digital Systems (1 teaching unit) • Seminar: Verification of Digital Systems (2 teaching units) • Practical class: Verification of Digital Systems (1 teaching unit) The classes are held in English.
Requirements for participation (recommended knowledge and skills)	none
Applicability of the module	---
Requirements for the award of credits	Fulfilment of the admission requirements for the assessment component and successful completion of the module examination are prerequisites for the award of credits. The admission requirements are the following examination prerequisites (repeatable without limit): • 15-minute presentation on a topic within the seminar Verification of Digital Systems • successfully certified practical class Verification of Digital Systems
Module examination	The module examination consists of one assessment component: • 90-minute written examination on Verification of Digital Systems (examination number: 42632) The assessment component is to be completed in English.
Credits and grades	5 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year in the summer semester.
Number of hours	The module requires students to complete a total of 150 study hours.
Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Specialisation module Test and Reliability

Module number	244036-065 (Version 02)
Module name	Numerical Methods for Materials and Reliability of Micro and Nano Systems
Module coordinator	Professorship of Materials and Reliability of Microtechnical Systems
Content and qualification objectives	Content: • Teaching of the fundamentals of FEM (theoretical and practical) • Modelling, mesh generation, boundary conditions and solution algorithms • Thermomechanical effects such as bending, thermal expansion, residual stresses, chemical shrinkage, diffusion and heat conduction • Modelling of elastic, elastic-plastic, visco-elastic and visco-plastic material behaviour • Determination of damage-mechanical failure parameters • Static and transient problems • Basic principles of crack description by fracture mechanics • Neural networks: fundamentals, training and validation, evaluation criteria • Examples from reliability prognostics Qualification objectives: Students have an overview of numerical methods of reliability assessment. They master the fundamentals of finite element modelling (FEM) with geometry construction, mesh design and selection of boundary conditions and understand the mathematical relationships underlying this method. In addition, they have knowledge of constitutive material equations and modelling strategies as a basis for the failure-physical evaluation and have a basic understanding of the use of neural networks. They are able to apply their knowledge to typical application-relevant problems in thermo-mechanics using the example of common packaging architectures.
Teaching methods	The teaching methods of the module are lecture and exercise class. • Lecture: Numerical Methods for Materials and Reliability of Micro and Nano Systems (2 teaching units) • Exercise class: Numerical Methods for Materials and Reliability of Micro and Nano Systems (2 teaching units) The classes are held in English.
Requirements for participation (recommended knowledge and skills)	Knowledge of the reliability of micro and nano systems (e.g. module Reliability of Micro and Nano Systems)
Applicability of the module	---
Requirements for the award of credits	Successful completion of the module examination is a prerequisite for the award of credits.
Module examination	The module examination consists of one assessment component: • Preparation of a complex finite element model (processing time: 4 weeks) and presentation of the model within a 15-minute presentation followed by a colloquium of at most 30 minutes (examination number: 42810) The assessment component may be completed in German or in English.
Credits and grades	5 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year in the summer semester.
Number of hours	The module requires students to complete a total of 150 study hours.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Specialisation module Test and Reliability

Module number	244036-075 (Version 02)
Module name	Failure Analytical Methods for Micro and Nano Systems
Module coordinator	Professorship of Materials and Reliability of Microtechnical Systems
Content and qualification objectives	Content: Motivation and link to the challenges of system integration: micro and nano systems, reliability, failure modes, industrial relevance; methods: optical microscopy and sample preparation, scanning acoustic microscopy (SAM), scanning electron microscopy (SEM) and focused ion beam technique (FIB), transmission electron microscopy (TEM), energy-dispersive X-ray spectroscopy (EDX), electron backscatter diffraction (EBSD), X-ray diffractometry (XRD) and X-ray tomography (XCT), Raman spectroscopy, atomic force microscopy (AFM), infrared thermography and excitation sources, thermoreflectance, X-ray photoelectron spectroscopy (XPS), characterisation at cryogenic temperatures (liquid nitrogen and liquid helium) Qualification objectives: Students have knowledge in the field of failure analysis methods for micro and nano systems and understand the underlying physical principles. They are able to apply their knowledge to typical scenarios in material and failure analysis within the scope of system integration in the micro and nano range. In doing so, they can establish a connection to thermo-mechanical reliability. From the practical class, they know typical results (failure patterns) as well as limitations and have knowledge of contrast formation and of parasitic effects. They have a strong interdisciplinary understanding of materials and electronic systems in fundamentals and application.
Teaching methods	The teaching methods of the module are lecture and practical class. • Lecture: Failure Analytical Methods for Micro and Nano Systems(2 teaching units) • Practical class: Failure Analytical Methods for Micro and Nano Systems (2 teaching units) The classes are held in English.
Requirements for participation (recommended knowledge and skills)	Basic knowledge of materials of electrical engineering and electronics (e.g. module Werkstoffe der Elektrotechnik/Elektronik)
Applicability of the module	---
Requirements for the award of credits	Fulfilment of the admission requirement for the assessment component and successful completion of the module examination are prerequisites for the award of credits. The admission requirement is the following examination prerequisite (repeatable without limit): • successfully certified practical class Failure Analytical Methods for Micro and Nano Systems
Module examination	The module examination consists of one assessment component: • 90-minute written examination on Failure Analytical Methods for Micro and Nano Systems (examination number: 42811) The assessment component is to be completed in English.
Credits and grades	5 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year in the winter semester.
Number of hours	The module requires students to complete a total of 150 study hours.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Specialisation module Test and Reliability

Module number	244038-035 (Version 02)
Module name	Smart Sensor Systems
Module coordinator	Professorship of Measurement and Sensor Technology
Content and qualification objectives	Content: • Introduction to intelligent sensor systems • Fundamentals of sensor technology • Sensor properties • Selected sensor principles • Design of sensor systems • Measurement data acquisition and sensor interfaces • Advanced methods of analogue-to-digital conversion • Sensor signal processing • Selected sensor applications Qualification objectives: Students are able to select sensors for measurement tasks in a suitable manner and to design the corresponding sensor systems and interfaces.
Teaching methods	The teaching methods of the module are lecture, exercise class and practical class. • Lecture: Smart Sensor Systems (2 teaching units) • Exercise class: Smart Sensor Systems (1 teaching unit) • Practical class: Smart Sensor Systems (2 teaching units) The classes are held in English.
Requirements for participation (recommended knowledge and skills)	none
Applicability of the module	---
Requirements for the award of credits	Fulfilment of the admission requirement for the assessment component and successful completion of the module examination are prerequisites for the award of credits. The admission requirement is the following examination prerequisite (repeatable without limit): • successfully certified practical class Smart Sensor Systems
Module examination	The module examination consists of one assessment component: • 120-minute written examination on Smart Sensor Systems (examination number: 42009) The assessment component is to be completed in English.
Credits and grades	6 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year in the winter semester.
Number of hours	The module requires students to complete a total of 180 study hours.
Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Specialisation module Design and Technology

Module number	212001-371 (Version 01)
Module name	Semiconductor Physics – Nano Structures
Module coordinator	Dean of Studies Physics of the Faculty of Natural Sciences
Content and qualification objectives	Content: Semiconductor physics / nanostructures: • Overview of semiconductors • Crystal structures: definitions and terms • Electronic band structure • Vibrational properties of semiconductors and electron-phonon interaction • Electronic properties of defects, classification of defects, effective mass, doping • Electrical transport phenomena, charge carrier mobility and scattering, temperature dependence, relaxation time • Optical properties, dielectric function, absorption by phonons, free charge carriers and bound electrons • S Surface effects, states and reconstructions • Quantum confinement effects on electrons and phonons in semiconductors • Quantum wells, wires, dots, superlattices, applications Qualification objectives: Understanding of the fundamentals and methods of semiconductor physics as well as of confinement effects in nanostructures
Teaching methods	The teaching methods of the module are lecture and exercise class. • Lecture: Semiconductor Physics – Nano Structures (3 teaching units) • Exercise class: Semiconductor Physics – Nano Structures (1 teaching unit) The classes are held in English.
Requirements for participation (recommended knowledge and skills)	none
Applicability of the module	---
Requirements for the award of credits	Successful completion of the module examination is a prerequisite for the award of credits.
Module examination	The module examination consists of one assessment component: • 90-minute written examination on Semiconductor Physics – Nano Structures (examination number: 11502) The assessment component is to be completed in English.
Credits and grades	5 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year in the summer semester.
Number of hours	The module requires students to complete a total of 150 study hours.
Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Specialisation module Design and Technology

Module number	244032-055 (Version 03)
Module name	Advanced Integrated Circuit Technology
Module coordinator	Professorship of Smart Systems Integration
Content and qualification objectives	Content: • Requirements and trends of the Semiconductor Technology Roadmap • Processes of micro and nanoelectronics (layer deposition, ion implantation, advanced lithography, etching/patterning, chemical-mechanical polishing, advanced cleaning methods) including new process steps • CMOS/bipolar/BiCMOS technology • CMOS process modules for modern IC technologies (STI, gate, source/drain, interconnect module, packaging etc.) • Specific aspects of sub-100 nm CMOS technology • New transistor and memory concepts, potential post-CMOS technologies • 3D technology for increasing the integration density • Numerical methods for semiconductor process and equipment simulation • Models and programming for advanced deposition methods (Monte Carlo and molecular dynamics calculations) • Parameter optimisation methods Qualification objectives: Students have developed an understanding of the fundamentals and trends of modern integrated circuit technology. They have knowledge of the process steps and modules, of the physical models for semiconductor processes, of the methodology and tools for process and equipment simulation and of practical programming.
Teaching methods	The teaching methods of the module are lecture and exercise class. • Lecture: Advanced Integrated Circuit Technology (3 teaching units) • Exercise class: Advanced Integrated Circuit Technology (1 teaching unit) The classes are held in English.
Requirements for participation (recommended knowledge and skills)	none
Applicability of the module	---
Requirements for the award of credits	Successful completion of the module examination is a prerequisite for the award of credits.
Module examination	The module examination consists of one assessment component: • 120-minute written examination on Advanced Integrated Circuit Technology (examination number: 42201) The assessment component is to be completed in English.
Credits and grades	5 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year in the summer semester.
Number of hours	The module requires students to complete a total of 150 study hours.
Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Specialisation module Design and Technology

Module number	244033-115 (Version 02)
Module name	Microsystems Design
Module coordinator	Professorship of Microsystems and Medical Engineering
Content and qualification objectives	Content: • Design methods and tools for microsystems technology (MST) • Modelling of heterogeneous systems with lumped parameters • Behaviour analysis of technical field problems with FEM • Macromodelling of complex systems by order reduction • Linking of component design and system design The focus is on the holistic consideration of various physical domains during the individual phases of the design process. Commercial design systems such as ANSYS/Multiphysics, Matlab/Simulink and languages such as VHDL-A or Verilog-A are used. Qualification objectives: Students have knowledge and skills for analytical and numerical modelling and simulation as well as for the design of heterogeneous complex systems of microsystems technology.
Teaching methods	The teaching methods of the module are lecture, exercise class and practical class. • Lecture: Microsystems Design (2 teaching units) • Exercise class: Microsystems Design (1 teaching unit) • Practical class: Microsystems Design (2 teaching units) The classes are held in English.
Requirements for participation (recommended knowledge and skills)	none
Applicability of the module	---
Requirements for the award of credits	Fulfilment of the admission requirement for the assessment component and successful completion of the module examination are prerequisites for the award of credits. The admission requirement is the following examination prerequisite (repeatable without limit): • successfully certified practical class Microsystems Design
Module examination	The module examination consists of one assessment component: • 120-minute written examination on Microsystems Design (examination number: 42115) The assessment component is to be completed in English
Credits and grades	6 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year in the winter semester.
Number of hours	The module requires students to complete a total of 180 study hours.
Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Specialisation module Design and Technology

Module number	244034-045 (Version 02)
Module name	Micro and Nano Devices
Module coordinator	Professorship of Electronic Devices of Micro and Nano Technology
Content and qualification objectives	Content: • MOS transistors with dimensions in the sub-100 nm range • New MOS transistor concepts (multi-gate transistors, FinFETs etc.) • Single-electron transistors • Quantum devices (resonant tunnelling diodes (RTDs) etc.) • Bipolar transistors with dimensions in the sub-1 µm range • Carbon nanotubes Qualification objectives: Students have knowledge of parasitic effects in MOS and bipolar devices with very small dimensions. They know fundamental novel devices, some of which only become possible through the production of very small structures.
Teaching methods	The teaching methods of the module are lecture, exercise class and practical class. • Lecture: Micro and Nano Devices (2 teaching units) • Exercise class: Micro and Nano Devices (1 teaching unit) • Practical class: Micro and Nano Devices (2 teaching units) The classes are held in English.
Requirements for participation (recommended knowledge and skills)	none
Applicability of the module	---
Requirements for the award of credits	Fulfilment of the admission requirement for the assessment component and successful completion of the module examination are prerequisites for the award of credits. The admission requirement is the following examination prerequisite (repeatable without limit): • successfully certified practical class Micro and Nano Devices
Module examination	The module examination consists of one assessment component: • 180-minute written examination on Micro and Nano Devices (examination number: 41409) The assessment component is to be completed in English.
Credits and grades	6 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year in the winter semester.
Number of hours	The module requires students to complete a total of 180 study hours.
Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Specialisation module Design and Technology

Module number	244037-025 (Version 02)
Module name	Flexible Electronics
Module coordinator	Professorship of Material Systems of Nanoelectronics
Content and qualification objectives	Content: The module Flexible Electronics conveys the fundamentals of the manufacture and use of flexible electronics. The basis is formed by organic and inorganic functional materials that are suitable for sensor technology, actuator technology, electronics and mechanical deformation. Fundamentals of the material properties and of the synthesis of relevant materials are taught. Questions on technological process compatibility are addressed and methods for the characterisation of flexible electronic devices are presented. These include electrical contacting, mechanical and electrical testing as well as optical and magnetic investigation. Qualification objectives: • Knowledge of the manufacturing principles of flexible electronics • Understanding of structural and electronic properties • Knowledge of material processing technologies and compatibilities • Knowledge of relevant characterisation methods
Teaching methods	The teaching methods of the module are lecture and exercise class. • Lecture: Flexible Electronics (2 teaching units) • Exercise class: Flexible Electronics (2 teaching units)
Requirements for participation (recommended knowledge and skills)	The students should be familiar with the fundamentals of electronics and chemistry.
Applicability of the module	---
Requirements for the award of credits	Successful completion of the module examination is a prerequisite for the award of credits.
Module examination	The module examination consists of one assessment component: • 120-minute written examination on Flexible Electronics (examination number: 41903)
Credits and grades	5 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is normally offered every academic year in the summer semester.
Number of hours	The module requires students to complete a total of 150 study hours.
Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Specialisation module Application of Integrated Circuits

Module number	243031-045 (Version 02)
Module name	Digital Components and Architectures for Data Processing
Module coordinator	Professorship of Circuit and System Design
Content and qualification objectives	Content: • Advanced architecture concepts of microprocessors and microcontrollers (control unit, arithmetic unit, memory, bus systems) • Other digital programmable circuits and IP cores • Classification and comparison options for digital circuits • Coupling of circuit types to form systems-on-chip • Efficient and hardware-oriented programming Qualification objectives: Students have detailed knowledge of the structure and function of basic computer components. They know the essential types of digital circuits, can define comparison criteria depending on the problem and make an optimal selection. They are able to use the special possibilities of computer architectures in software programming.
Teaching methods	The teaching methods of the module are seminar and exercise class. • Seminar: Digital Components and Architectures for Data Processing (2 teaching units) • Exercise class: Digital Components and Architectures for Data Processing (2 teaching units) The classes are held in English.
Requirements for participation (recommended knowledge and skills)	Basic knowledge of the structure of a computer (e.g. from the module Mikroprozessortechnik 1)
Applicability of the module	---
Requirements for the award of credits	Successful completion of the module examination is a prerequisite for the award of credits.
Module examination	The module examination consists of one assessment component: • 120-minute written examination on Digital Components and Architectures for Data Processing (examination number: 42614) The assessment component is to be completed in English.
Credits and grades	5 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year in the winter semester.
Number of hours	The module requires students to complete a total of 150 study hours.
Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Specialisation module Application of Integrated Circuits

Module number	243032-055 (Version 03)
Module name	Multisensorial Systems
Module coordinator	Professorship of Communications Engineering
Content and qualification objectives	Content: • Introduction to the modelling of vague matters • Modelling of vague matters with the aid of probability theory • Modelling of dynamic systems with a focus on state-space description • Dynamic models and disturbance modelling • Measurement models (including laser scanners, radar, video images) • Fundamentals of estimation theory • Kalman filtering • Kalman filters in examples and applications • Kalman filters for tracking objects (e.g. vehicles or pedestrians) • Multi-Kalman filters for the simultaneous tracking of several objects • Sensor data fusion (including laser scanners and video images) • Extensions and special cases of the Kalman filter Qualification objectives: Students know the fundamentals of estimation theory and of the fusion of multivariate data.
Teaching methods	The teaching methods of the module are lecture and practical class. • Lecture: Multisensorial Systems (3 teaching units) • Practical class: Multisensorial Systems (1 teaching unit) The classes are held in English.
Requirements for participation (recommended knowledge and skills)	none
Applicability of the module	---
Requirements for the award of credits	Fulfilment of the admission requirement for the assessment component and successful completion of the module examination are prerequisites for the award of credits. The admission requirement is the following examination prerequisite (repeatable without limit): • successfully certified practical class Multisensorial Systems
Module examination	The module examination consists of one assessment component: • 90-minute written examination on Multisensorial Systems (examination number: 42316) The assessment component is to be completed in English.
Credits and grades	5 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year and begins in each case in the winter semester.
Number of hours	The module requires students to complete a total of 150 study hours.
Module duration	Under normal circumstances, the module is completed in two semesters.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Specialisation module Application of Integrated Circuits

Module number	243033-045 (Version 02)
Module name	Digital Signal Processing 1
Module coordinator	Professorship of Digital and Circuit Technology

Content and qualification objectives	Content:
	• Sampling and reconstruction
	• Quantisation
	  ○ A/D converters
	  ○ D/A converters
	  ○ Quantisation noise
	  ○ Oversampling
	• Discrete systems
	  ○ Linearity and time invariance
	  ○ Causality and stability
	• Digital filters
	  ○ Z-transform
	  ○ FIR filters
	  ○ IIR filters
	
	Qualification objectives: Students know the fundamentals of digital signal processing and are able to design and program signal processing algorithms independently.

Teaching methods	The teaching methods of the module are lecture and seminar. • Lecture: Digital Signal Processing 1 (2 teaching units) • Seminar: Digital Signal Processing 1 (2 teaching units) The classes are held in English.
Requirements for participation (recommended knowledge and skills)	none
Applicability of the module	---
Requirements for the award of credits	Successful completion of the module examination is a prerequisite for the award of credits.
Module examination	The module examination consists of one assessment component: • 120-minute written examination on Digital Signal Processing 1 (examination number: 41232) The assessment component is to be completed in English.
Credits and grades	5 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year in the winter semester.
Number of hours	The module requires students to complete a total of 150 study hours.
Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Specialisation module Application of Integrated Circuits

Module number	243033-095 (Version 02)
Module name	Programming and Data Analysis
Module coordinator	Professorship of Digital and Circuit Technology
Content and qualification objectives	Content: Within the module, basic skills in relevant programming and analysis tools of scientific computing are taught. Using practice-oriented examples, problems from the field of information technology are worked on. In addition to the teaching of theoretical knowledge, the focus is on practice-oriented implementations in the areas of: • Data I/O • Data visualisation • Matrix calculation Qualification objectives: Students are able to implement complex programming tasks independently in practice.
Teaching methods	The teaching methods of the module are lecture and seminar. • Lecture: Programming and Data Analysis (1 teaching unit) • Seminar: Programming and Data Analysis (4 teaching units) The classes are held in English.
Requirements for participation (recommended knowledge and skills)	Basic knowledge of object-oriented programming
Applicability of the module	---
Requirements for the award of credits	Fulfilment of the admission requirement for the assessment component and successful completion of the module examination are prerequisites for the award of credits. The admission requirement is the following examination prerequisite (repeatable without limit): • practical implementation of a complex programming task (processing time: 6 weeks)
Module examination	The module examination consists of one assessment component: • 120-minute written examination on Programming and Data Analysis (examination number: 41203 The assessment component is to be completed in English.
Credits and grades	5 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year in the summer semester.
Number of hours	The module requires students to complete a total of 150 study hours.
Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Practice-oriented specialisation module

Module number	240100-434 (Version 01)
Module name	Research Internship
Module coordinator	Dean of Studies for the Master's degree programme Design and Test for Integrated Circuits at the Faculty of Electrical Engineering and Information Technology
Content and qualification objectives	Content: The students independently work on a practical task in the field of electrical engineering and information technology. This should have a close connection with the subject area of design and test of integrated circuits. The practical training takes place within the scope of a 20-week activity totalling 800 study hours in a company or in a research or development institution and is normally to be completed in Germany. Before the start of the internship, a professorship of the Faculty of Electrical Engineering and Information Technology must confirm in writing that the task to be worked on at the internship institution is thematically suitable and appropriate in terms of level for the present Master's degree programme. Qualification objectives: The student is able to work independently on an engineering problem in practice, to record the results in writing and to present them to a specialist audience. In addition, he or she can acquire missing knowledge necessary for carrying out the tasks through professional exchange with other engineers or through independent research in the specialist literature.
Teaching methods	The teaching method of the module is the internship. • Internship: Research Internship (800 study hours)
Requirements for participation (recommended knowledge and skills)	German language skills at level B2 of the Common European Framework of Reference for Languages
Applicability of the module	---
Requirements for the award of credits	Fulfilment of the admission requirements for the assessment component and successful completion of the module examination are prerequisites for the award of credits. The admission requirements are: • modules totalling at least 30 Cr • written confirmation of the internship task by a professorship of the Faculty of Electrical Engineering and Information Technology before the start of the internship
Module examination	The module examination consists of one assessment component: • Preparation of a written internship report (scope: approx. 30 pages, processing time: 3 weeks) and presentation of the contents of the internship report in a 30-minute colloquium (examination number: 40002)
Credits and grades	30 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year.
Number of hours	The module requires students to complete a total of 900 study hours.
Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Practice-oriented specialisation module

Module number	240100-634 (Version 01)
Module name	Research Project
Module coordinator	Dean of Studies for the Master's degree programme Design and Test for Integrated Circuits at the Faculty of Electrical Engineering and Information Technology
Content and qualification objectives	Content: The student independently works out, at a professorship of the Faculty of Electrical Engineering and Information Technology, the solution to a practically oriented task from the field of design and test of integrated circuits. The module is to be worked on independently in accordance with the task set. The academic supervisor of the Research Project is to be consulted regularly. The module is divided into 3 milestones: • MS1: Issue of the topic (week 1) • MS2: Presentation of the solution concept (week 4) • MS3: Submission of the written paper, presentation of the results (week 15) The topic of the project work must be confirmed in writing by the supervising professorship before work begins. Qualification objectives: The student is able to solve an engineering research task independently and to document, analyse and present the results.
Teaching methods	The teaching methods of the module are seminar and project. • Seminar: Research Project (1 teaching unit) • Project: Research Project (1 teaching unit) The classes are held in English.
Requirements for participation (recommended knowledge and skills)	none
Applicability of the module	---
Requirements for the award of credits	Fulfilment of the admission requirement for the assessment component and successful completion of the module examination are prerequisites for the award of credits. The admission requirement is the following examination prerequisite (repeatable without limit): • written paper on the concept of the project work, including a time and resource plan for further work on the task (scope: 2-5 pages, processing time: 4 weeks), and presentation of the concept in the form of a 10-minute oral presentation The examination prerequisite may be completed in English or in German.
Module examination	The module examination consists of one assessment component: • written paper (scope: 20-30 pages, processing time: 11 weeks) on the topic of the project work and 20-minute oral presentation of the results of the project work (examination number: 40003) The assessment component may be completed in English or in German.
Credits and grades	10 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Number of hours	The module requires students to complete a total of 300 study hours.
Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Practice-oriented specialisation module

Module number	243031-095 (Version 02)
Module name	Applied Circuit Design and Testing
Module coordinator	Professorship of Circuit and System Design
Content and qualification objectives	Content: • Design process and tools for digital ICs (Intergrated Circuits), in particular FPGAs (Field Programmable Gate Arrays) • Presentation of fields of application (including rapid prototyping, signal, data and image processing) • Test tools, test machines • Creation of test cases, performance of tests • Processing of complex design tasks Qualification objectives: Students are able to convert a given specification into a digital system and to verify the solution. They have in-depth knowledge of the necessary development steps and tools. They are able to test information-electronics circuits and to assess the quality of the solution achieved.
Teaching methods	The teaching methods of the module are seminar and practical class. • Seminar: Applied Circuit Design and Testing (2 teaching units) • Practical class: Applied Circuit Design and Testing (4 teaching units) The classes are held in English.
Requirements for participation (recommended knowledge and skills)	Fundamentals of a hardware description language (e.g. module Design of Heterogeneous Systems) and fundamentals of digital testing (e.g. module Test of Digital and Mixed-Signal Circuits)
Applicability of the module	---
Requirements for the award of credits	Successful completion of the module examination is a prerequisite for the award of credits.
Module examination	The module examination consists of one assessment component: • 10-minute oral presentation of the solution to a complex design or test task from the field of digital ICs, followed by a 20-minute colloquium on the module content (examination number: 42619) The assessment component may be completed in English or in German.
Credits and grades	8 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year in the winter semester.
Number of hours	The module requires students to complete a total of 240 study hours.
Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Practice-oriented specialisation module

Module number	243031-135 (Version 01)
Module name	Layout of ICs and PCBs
Module coordinator	Professorship of Circuit and System Design
Content and qualification objectives	Content: • Selection and placement of components • Routing of interconnections • Optimisation algorithms for placement and routing • Tools for automatic layout • Layer structure of integrated circuits (ICs) and printed circuit boards (PCBs) • Mounting chiplet/chip or chip/PCB • Consideration of electromagnetic compatibility • Consideration of testability in the layout Qualification objectives: Students are able to create a practicable circuit/integrated circuit concept and to implement it in a testable layout. They know the similarities and differences in the layout of integrated circuits and printed circuit boards as well as corresponding software tools. They are aware of the problems arising in manufacturing/assembly and test and can already take countermeasures into account during layout.
Teaching methods	The teaching methods of the module are seminar and practical class. • Seminar: Layout of ICs and PCBs (2 teaching units) • Practical class: Layout of ICs and PCBs (3 teaching units) The classes are held in English.
Requirements for participation (recommended knowledge and skills)	Module Elements of Integrated Circuits
Applicability of the module	---
Requirements for the award of credits	Successful completion of the module examination is a prerequisite for the award of credits.
Module examination	The module examination consists of one assessment component: • Preparation of a circuit/integrated circuit concept (processing time: approx. 3 weeks), of an associated layout design (processing time: approx. 4 weeks) and their presentation in a 20-minute colloquium (examination number: 42622) The assessment component may be completed in English or in German.
Credits and grades	7 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year in the summer semester.
Number of hours	The module requires students to complete a total of 210 study hours.
Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Cross-cutting specialisation module

Module number	220000-605 (Version 02)
Module name	Optimierung in den Anwendungen
Module coordinator	Dean of Studies for all degree programmes of the Faculty of Mathematics (except the degree programmes Data Science, MINT, Advanced and Computational Mathematics)
Content and qualification objectives	Content: Mathematical optimisation deals with the task of minimising an objective function over a given feasible set. The module is designed for non-mathematical degree programmes and gives a rough overview of methods and techniques for formulating and solving classes of fundamental optimisation problems and for critically interpreting the solution information. Qualification objectives: Students are able to formulate and classify optimisation problems correctly, to model them in a goal-oriented way, to choose suitable solution methods on the basis of knowledge of the fundamentals and an understanding of how they work, to interpret and question results critically and to implement simple solution methods algorithmically themselves. Teamwork skills are promoted through group work in the exercise classes.
Teaching methods	The teaching methods of the module are lecture and exercise class. • Lecture: Optimierung in den Anwendungen (2 teaching units) • Exercise class: Optimierung in den Anwendungen (2 teaching units) The classes may be held in German or in English.
Requirements for participation (recommended knowledge and skills)	Familiarity with basic concepts of linear algebra and multidimensional differential calculus
Applicability of the module	non-mathematical degree programmes with mathematical basic training
Requirements for the award of credits	Successful completion of the module examination is a prerequisite for the award of credits.
Module examination	The module examination consists of one assessment component: • 30-minute oral examination on Optimierung in den Anwendungen (examination number: 22201) The assessment component may be completed in German or in English.
Credits and grades	6 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year.
Number of hours	The module requires students to complete a total of 180 study hours.
Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Cross-cutting specialisation module

Module number	243031-145 (Version 01)
Module name	Advanced Methods for Integrated Circuits
Module coordinator	Professorship of Circuit and System Design
Content and qualification objectives	Content: The research and development field of integrated circuits is characterised by constant change and further development. Within the framework of this module, current developments in this field are taken up and presented to the students. An excursion to a non-university research or development institution provides insight into the application of the knowledge acquired in the degree programme. Qualification objectives: Students have an overview of current topics and research priorities in the field of design and test of integrated circuits. The students get to know a research or development institution outside the university.
Teaching methods	The teaching methods of the module are seminar and excursion. • Seminar: Advanced Methods for Integrated Circuits (3 teaching units) • Excursion: Advanced Methods for Integrated Circuits (1 teaching unit) The classes are held in English; the excursion is held as a block event.
Requirements for participation (recommended knowledge and skills)	none
Applicability of the module	---
Requirements for the award of credits	Successful completion of the module examination is a prerequisite for the award of credits.
Module examination	The module examination consists of one assessment component: • 20-minute oral examination on the content of the module (examination number: 42623) The assessment component is to be completed in English.
Credits and grades	5 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment component is assessed and how the module grade is calculated.
Frequency	The module is offered every academic year.
Number of hours	The module requires students to complete a total of 150 study hours.
Module duration	Under normal circumstances, the module is completed in one semester.

Non-binding English translation for information only. Only the official German documents are legally binding.

Annex 2: Module description for the English-language consecutive degree programme in Design and Test for Integrated Circuits leading to the award of Master of Science

Master's thesis module

Module number	240100-834 (Version 02)
Module name	Master Thesis
Module coordinator	Dean of Studies for the Master's degree programme Design and Test for Integrated Circuits at the Faculty of Electrical Engineering and Information Technology
Content and qualification objectives	Content: The module comprises the preparation of the Master's thesis on an engineering task, its written presentation and an oral examination. The topic of the Master's thesis should lie in the field of design and test of integrated circuits. The student is supported in this by a scientific supervisor of the Faculty. Qualification objectives: The student is able to work on an engineering task, to present solution approaches and results in writing and to present them.
Teaching methods	The module is to be worked on independently in accordance with the task set. The academic supervisor of the Master's thesis is to be consulted regularly.
Requirements for participation (recommended knowledge and skills)	none
Applicability of the module	---
Requirements for the award of credits	Fulfilment of the admission requirements for the individual assessment components and successful completion of the module examination are prerequisites for the award of credits. The admission requirements are: • for the preparation of the Master's thesis: modules totalling at least 82 Cr • for the colloquium: all modules (except the Master's thesis module)
Module examination	The module examination consists of two assessment components. Specifically, the following assessment components are to be completed: • Master's thesis (scope: approx. 60 pages; processing time: 23 weeks) (examination number: I_M_DT-9110) • Colloquium (30-minute oral presentation with subsequent discussion of at most 15 minutes) (examination number: I_M_DT-9120) The assessment components are to be completed in English.
Credits and grades	30 credits are earned in the module. Section 10 of the Examination Regulations specifies how the assessment components are assessed and how the module grade is calculated. Assessment components: • Master's thesis, weighting 7 – pass required • Colloquium, weighting 3 – pass required
Frequency	The module is offered every academic year.
Number of hours	The module requires students to complete a total of 900 study hours.
Module duration	Under normal circumstances, the module is completed in one semester.