Appendix 1
Module Descriptions

Content

Please note: This is an English translation of the German original. **Only the German version is legally binding**

Compulsory Modules

Module Number	Module Name	Lecturer in Charge
NES-12 ASW	Academic and Scientific Work	Studiendekan
Contents and Objectives	After completion of the module students have the key competencies for the academic and scientific work. They can deal critically with scientific texts or pass on their knowledge to others and monitor their learning process. This includes understanding the essential content of scientific texts, their integration into the current scientific context, the critical reflection of social, economic and cultural impact as well as their representation and presentation. To stimulate and to enable the development of knowledge among learners the students have acquired knowledge of the general academic teaching and can apply this.	
Modes of Teaching and Learning	The module includes lectures, tutorials, labs, seminars and self study for a total of 120 hours. The courses are choosen in the specified amount from the catalog "Wissenschaftliches Arbeiten (Scientific Work)". The catalog is given inclusive of the required examinations at the beginning of the semester faculty usually known.	
Prerequisites		
Usability	The module is a compulsory module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module test is passed. The assessment consists of the prescribed examinations according to the catalog "Wissenschaftliches Arbeiten (Scientific Work)".	
Credit Points and Grades	4 credit points can be obtained by the module. The grade is derived from the arithmetic mean of the grades of the individual examinations.	
Frequency	The module will be offered every winter semester.	
Work Load	The total effort is 120 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-12 10 01	Fundamentals of Estimation and Detection	Prof. Fettweis
Contents and Objectives	After completion of the module the students know the key approaches for parameter estimation and detection as well as the basics of linear estimation techniques and of memory-afflicted systems. They understand the different mathematical models and approaches that the current methods are based, and thus they are able to select and apply the appropriate procedures for various practical scenarios. Students can evaluate different estimators / detectors on the basis of quality criteria.	
Modes of Teaching and Learning	The module consists of 2 hours per week lectures, 2 hours per week tutorials and self-study.	
Prerequisites	Knowledge in system theory and basic knowledge in stochastic on bachelor level	
Usability	The module is a compulsory module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consists of an oral exam as an indivudual exam worth 30 minutes.	
Credit Points and Grades	6 credit points can be obtained by the module. The module grade is the grade of the examination.	
Frequency	The module will be offered every winter semester.	
Work Load	The total effort is 180 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-12 10 03	Hardware/Software Codesign	Prof. Fettweis
Contents and Objectives	The module content includes: - Methods and different aspects of hardware and software implementation of embedded systems (including telecommunications). - Mutual influence of both designs (co-design) in order to optimize the circuit design, - New arallel processing concepts through massive structure reduction towards the "Nano Scale". Objectives: After completing this module, students have an overview of current hardware systems, specifically the various hardware platforms for software implementation of digital signal processing algorithms, and can evaluate these with respect to various criteria (eg, flexibility, power consumption). Students can derive from algorithms the hardware requirements in compliance with the requirements of flexibility for the hardware and software components. They know strategies to enhance performance and minimize power consumption and can apply them safely	
Modes of Teaching and Learning	The module consists of 2 hours per week lectures, 1 hour per week tutorials and self-study.	
Prerequisites		
Usability	The module is a compulsory module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consists of a written exam in the amount of 120 minutes, if the number of participants exceeds 16. With up to 16 participants the written exam is replaceed by an oral exam as individual exam worth 20 minutes. The nature of the specific exam is announced at the end of the registration period as usually known from the faculty.	
Credit Points and Grades	4 credit points can be obtained by the module. The module grade is the grade of the examination.	
Frequency	The module will be offered every summer semester.	
Work Load	The total effort is 120 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-11 06 01	Lab Sessions	Prof. Fetzer
Contents and Objectives	This module provides the practical skills and abilities in the field of embedded system design and semiconductor manufacturing. Participants gain experience in teamwork and project work and deepen their skills in lecture and presentation techniques. After completing the module the students have a first state of knowledge on issues of embedded system design and have some experience with the most important process steps in semiconductor manufacturing.	
Modes of Teaching and Learning	The module constists of two labs ("Embedded System Design Lab" und "Solar Cell Building Lab") with self-study with an amount of 75 hours for each.	
Prerequisites		
Usability	The module is a compulsory module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consists of two lab protocols.	
Credit Points and Grades	5 credit points can be obtained by the module. The module grade is the arithmetic mean of the grades of the lab protocols.	
Frequency	The module will be offered every winter semester.	
Work Load	The total effort is 150 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-11 06 02	Principles of Dependable Systems	Prof. Fetzer
Contents and Objectives	After the successful completion of this module, students are able to design and to implement highly reliable and secure systems. Special skills they acquired for the design of distributed protocols for critical systems, due the variety of possible error and failure types in this area. Based on their theoretical knowledge, students can design effective solutions to practical scenarios.	
Modes of Teaching and Learning	The module consists of 2 hours per week lectures, 2 hours per week tutorials and self-study.	
Prerequisites	Participants should be familar with the basics of design, development and operation of computer-based systems (bachelor level).	
Usability	The module is a compulsory module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consists of an oral exam as an individual exam worth 30 minutes. A collection of exercises must be solved as examination requirements.	
Credit Points and Grades	6 credit points can be obtained by the module. The module grade is the grade of the examination.	
Frequency	The module will be offered every winter semester.	
Work Load	The total effort is 180 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-12 PW	Project Work	Studiendekan
Contents and Objectives	Contents: - Research, development, modeling, analysis, planning, design, system design, programming, - Implementation and coding, operation, maintenance, verification and testing, commissioning, Outcomes: The students have expertise in handling complex problems in modern engineering professional practice and to document and present their results. They have social skills of professional communication, project and product management.	
Modes of Teaching and Learning	The module includes projects amounting to 10 weeks and self-study.	
Prerequisites		
Usability	The successful completion of the module is a prerequisite for the start of Master Thesis.	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consists of the project report in the amount of 100 hours.	
Credit Points and Grades	10 credit points can be obtained by the module. The module is rated with "pass" or "fail".	
Frequency	The module will be offered every winter semester.	
Work Load	The total effort is 300 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-12 08 02	Radio Frequency Integrated Circuits	Prof. Ellinger
Contents and Objectives	The module content includes: - High frequency integrated circuits for high speed wireless communications such as low noise amplifiers, power amplifiers, mixers, oscillators on basis of active and passive devices, as well as complete radio frontends and architectures, are lectured. - Advantages and challenges of aggressively scaled CMOS and BiCMOS, Moore than Moore (e.g. FinFET, SOI, strained silicon) and Beyond more Moore (silicon nano wire, CNT and organic) technologies are discussed from circuit design perspective. Qualification goals: Students obtain competences regarding - Methods for the design of analog high frequency integrated circuits. They know the basic circuits and architectures of the systems for - the analysis and optimisation of these circuits, and - complete design cycle for high frequency integrated circuits using the Cadance CAD system.	
Modes of Teaching and Learning	The module consists of 3 hours per week lectures, 1 hour per week tutorials, 2 hours per week practical training and self-study.	
Prerequisites	Basic knowledge in circuit design on bachelor level is required.	
Usability	The module is a compulsory module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment is a written exam in the amount of 120 minutes. The exam can be taken in German or English.	
Credit Points and Grades	7 credit points can be obtained by the module. The module grade is the grade of the examination.	
Frequency	The module will be offered every summer semester.	
Work Load	The total effort is 210 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-12 12 02	Semiconductor Technology	Prof. Bartha
Contents and Objectives	The module contains: The technological basics for the fabrication of micro- and nano devices as well as the manufacturing concepts for integrated circuits. Objectives: The students are enabled to - know the function of the process steps for the fabrication of micro- and nano devices, - know the fundamental principles for the fabrication and miniaturization of devices and integrated circuits, - know the interrelation of the individual process steps to complex process schemes.	
Modes of Teaching and Learning	The module consists of 6 hours per week lectures, 1 hour per week practical training and self-study.	
Prerequisites		
Usability	The module is a compulsory module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consist of a written exam in the amount of 120 minutes, if the number of participants exceeds 20. With up to 20 participants the witten exam will be replace by an oral exam as an individual exam worth 30 minutes. The nature of the specific exam is announced at the end of the registration period as usually known from the faculty.	
Credit Points and Grades	11 credit points can be obtained by the module. The module grade is the grade of the examination.	
Frequency	The module will be offered every winter semester.	
Work Load	The total effort is 330 hours.	
Duration	The module takes two semester.	

Elective Modules

Module Number	Module Name	Lecturer in Charge
NES-12 10 02	Communications	Prof. Fettweis
Contents and Objectives	The module content includes: Signal theory (sine waves, Dirac function, convolution, Fourier transform), linear time-invariant systems (transfer function, impulse response) bandpass signals (real and complex up and downward mixing of signals, equivalent lowpass signal), analog modulation (modulation, demodulation, properties of AM , PM, FM), analog-digital conversion (sampling, signal reconstruction, quantization, sub- and over sampling), digital modulation schemes (modulation methods, matched-filter receiver, bit error probability). Outcomes: After completing this module, students master the basic principles and practical application of communications. The students will be able to understand the basic signal processing in communications systems and to describe them mathematically. They are familiar with the transmission in base band and band-pass area and know the basic analog and digital modulation methods. They understand for simple analog and digital transmission scenarios the impact of noise on the transmission quality.	
Modes of Teaching and Learning	The module consists of 2 hours per week lectures, 1 hour per week tutorials and self-study.	
Prerequisites	It is assumed the powers in the field of systems theory (analog and digital systems) and higher mathematics at Bachelor level.	
Usability	The module is an elective module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consists of a written exam in the amount of 120 minutes.	
Credit Points and Grades	3 credit points can be obtained by the module. The module grade is the grade of the examination.	
Frequency	The module will be offered every summer semester.	
Work Load	The total effort is 90 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-11 02 03	Computer Arithmetic	Prof. Spallek
Contents and Objectives	Contents / Topics - design of binary adder circuits (rippling, block parallel, hierarchical) - carry-save and signed-digit number representations - multi-operand addition, generalized counters - multiplication - division by digit recurrence and by numerical approximation - square rooting - CORDIC algorithms - general function evaluation Qualifications / Competences - ability to describe the implementation of arithmetic operations and their associated complexities in space and time - ability to construct custom arithmetic circuits according to set design goals	
Modes of Teaching and Learning	The module consists of 2 hours per week lectures, 2 hours per week tutorials and self-study.	
Prerequisites		
Usability	The module is an elective module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consists of an oral exam worth 45 minutes.	
Credit Points and Grades	6 credit points can be obtained by the module. The module grade is the grade of the examination.	
Frequency	The module will be offered every winter semester.	
Work Load	The total effort is 180 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-12 12 04	Electromechanical Networks	Prof. Fischer
Contents and Objectives	The students - are skilled with the basic methodological and practical knowledge to analyse and to design effectively the dynamic behavior of coupled electromechanical, magnetic and fluidic systems using a circuit representation of the different subsystems including their interactions based on network theory, - master the function and modelling of electromechanical transducers, - can simulate the behavior of electromechanical systems with existing circuit simulation software such as Spice.	
Modes of Teaching and Learning	The module consists of 2 hours per week lectures, 1 hour per week tutorials and self-study.	
Prerequisites	Basic knowledge on bachelor level of electrical circuits, sophomore level mathematics (calculus and elementary linear algebra).	
Usability	The module is an elective module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consists of written exam in the amount of 120 minutes.	
Credit Points and Grades	4 credit points can be obtained by the module. The module grade is the grade of the examination.	
Frequency	The module will be offered every winter semester.	
Work Load	The total effort is 120 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-30 GLC	German Language and Culture	Carlos Ampié Loría
Contents and Objectives	Content of the module: German lessons with regional and cultural topics Objective: Knowledge about German everyday language (written and spoken) on A1-Level of the CEFR	
Modes of Teaching and Learning	The module consists of 4 hours per week language courses and self-study.	
Prerequisites		
Usability	The module is an elective module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consists of a written exam with the amount of 90 minutes.	
Credit Points and Grades	4 credit points can be obtained by the module. The module grade is the grade of the examination.	
Frequency	The module will be offered every summer semester.	
Work Load	The total effort is 120 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-12 10 04	Hardware/Software Codesign Lab	Dr. Matus
Contents and Objectives	Content of the module: Approaches to accelerate digital signal processing algorithms Outcomes: The students know the ASIP design methodology (Application Specific Instruction Processor). They can independently implement algorithms and are able to participate with their own contributions to discussions about the complexity, memory usage, layout of data in the memory architecture and possible improvements.	
Modes of Teaching and Learning	The module consists of 1 hour per week tutorials, 2 hours per week practical training and self-study.	
Prerequisites	Knowledge in Hardware/Software Codesign, as e.g. are taught in the module "Hardware/Software Codesign", and basic knowledge in assembly language programming, Matlab and DSP architecture concepts on bachelor level.	
Usability	The module is an elective module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consists of a project report in the scope of 30 hours.	
Credit Points and Grades	4 credit points can be obtained by the module. The module grade is the grade of the examination.	
Frequency	The module will be offered every winter semester.	
Work Load	The total effort is 120 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-11 02 01	High Level Synthesis	Prof. Hochberger
Contents and Objectives	Contents of the module: - Mapping of behavioral descriptions (e.g. in the form of program fragments) on FPGA and CGRGA structures - Task allocation, scheduling, binding - Exact or heuristic solutions - Design principles of heuristic solutions - State encoding Students that have completed this module know alternative approaches for all of the tasks of the high level synthesis and can select appropriate ones for specific applications. They can evaluate the memory and time complexity of the given algorithms. They are enabled to adapt the algorithms for new constraints and new target technologies.	
Modes of Teaching and Learning	The module consists of 2 hours per week lectures, 2 hours per week tutorials and self-study.	
Prerequisites	Knowledge of hardware synthesis on the basis of at least one hardware description language (e.g. Reese/Thornton: Introduction to Logic Synthesis Using Verilog Hdl oder Brown/Vranesic: Fundamentals of Digital Logic with VHDL Design) is required. Also, the thorough understanding of at least one high level programming language (C and/or Java) is required.	
Usability	The module is an elective module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consists of an oral exam (individual exam) worth 30 minutes.	
Credit Points and Grades	6 credit points can be obtained by the module. The module grade is the grade of the examination.	
Frequency	The module will be offered every winter semester.	
Work Load	The total effort is 180 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-12 08 04	Integrated Circuits for Broadband Optical Communication	Prof. Ellinger
Contents and Objectives	The module content includes: - Design of integrated circuits in aggressively scaled nanotechnologies, focusing on the broadband optical communications - Transimpedance amplifier, detector circuits, laser drivers, multiplexers, frequency dividers, oscillators, phase locked loops, synthesizers and data recovery circuits - Challenges (eg, high bandwidth, gain, noise and good large signal performances despite of lower voltages) and appropriate solutions for circuits in nanotechnology Qualication goals: Students obtain competences regarding - methods for the design of very fast integrated circuits and systems for optical communications, - the analysis and optimisation of these circuits, and - complete design cycle of circuits for optical communications using the Cadance CAD system.	
Modes of Teaching and Learning	The module consists of 3 hours per week lectures, 1 hour per week tutorials, 2 hours per week practical training and self-study.	
Prerequisites	Basic knowledge in analog circuit design on Bachelor level is required.	
Usability	The module is an elective module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consists of a written exam in the amount of 120 minutes. The exam can be written either in German or Englisch.	
Credit Points and Grades	7 credit points can be obtained by the module. The module grade is the grade of the written exam.	
Frequency	The module will be offered every winter semester.	
Work Load	The total effort is 210 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-10 01 01	Investing in a Sustainable Future	Prof. E. Günther
Contents and Objectives	Contents of the module: How to create innovation for a sustainable future? - Basics and history of innovation and the implementation of innovation in organisations - Definition, assessment and concrete application within organizations of sustainable issues of organizational decisions - Different perspectives on entrepreneurial decisions Qualification objectives: Students taking this course achieve to include ecological and economical aspects of Corporate Social Responsibility in their decisions making and understand the basics of innovation management. Furthermore, they can work in interdisciplinary and intercultural teams, develop themselves solutions and present them in writing and which they present in written and oral form.	
Modes of Teaching and Learning	The module consists of 1 hours per week lectures, 2 hours per week seminars and self-study.	
Prerequisites		
Usability	The module is an elective module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consists of a project report in scope of 45 hours, a colloquium in the extent of 20 minutes and an oral exam as individual exam worth 20 minutes.	
Credit Points and Grades	4 credit points can be obtained by the module. The module grade is calculated from the weighted grades of the project (factor 2), the colloquium (factor 1) and the oral exam (factor 1).	
Frequency	The module will be offered every summer semester.	
Work Load	The total effort is 120 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-12 08 01	Lab VLSI Processor Design	Prof. Schüffny
Contents and Objectives	Content of the module: - Basics, concepts and methods for designing complex digital VLSI-systems - Architectures for highly integrated digital processing systems, with emphasis on user-specific signal processing systems - Methods for the efficient transfer of architectural concepts in the highly integrated implementation of a digital system. - Specification and abstract modelling of the system, conversion into a Register-Transfer-Level (RTL) description, automated circuit synthesis and physical implementation (place & route, layout synthesis), delivering the data for the manufacture of the chip. - Verification of the design on all levels of abstraction (behaviour, implementation) via simulation (functional verification) - Proof of the equivalence of transformation steps via formal verification, i.e. by checking compliance with design rules (signoff-verification) - Training in working together as a design team (division of tasks, definition of interfaces, schedule planning and time management) Objectives: After completion of this module, the students will be able to carry out a complete implementation and verification of a VLSI-System (e. g. a processor with a complexity comparable to an 8051) using industrial design software (Synopsys, Cadence).	
Modes of Teaching and Learning	The module consists of 4 hours per week tutorials and self-study.	
Prerequisites		
Usability	The module is an elective module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consists of a project report with in scope of 30 hours.	
Credit Points and Grades	6 credit points can be obtained by the module. The module grade is the grade of the project.	
Frequency	The module will be offered every winter semester.	
Work Load	The total effort is 180 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-11 02 02	Low Level Synthesis	Prof. Hochberger
Contents and Objectives	Contents of the module: - All abstraction layers between logic level and physical level - Logic minimization methods (exact and heuristic, for two level and multi level logic) - Technology mapping using functional decomposition and structural approaches (e.g. FlowMap) - Analytical and heuristic placer (simulated annealing, genetic algorithms) - Typical wiring algorithms (PathFinder) After completion of the module the students can analyze the synthesis algorithms and procedures. They can evaluate these with respect to their memory and time complexity, and their applicability to specific target technologies. Students can transfer known methods to new architectures and technologies.	
Modes of Teaching and Learning	The module consists of 2 hours per week lectures, 2 hours per week tutorials and self-study.	
Prerequisites	Knowledge of hardware synthesis on the basis of at least one hardware description language (e.g. Reese/Thornton: Introduction to Logic Synthesis Using Verilog Hdl oder Brown/Vranesic: Fundamentals of Digital Logic with VHDL Design) is required.	
Usability	The module is an elective module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consists of an oral exam (individual exam) worth 30 minutes.	
Credit Points and Grades	6 credit points can be obtained by the module. The module grade is the grade of the examination.	
Frequency	The module will be offered every summer semester.	
Work Load	The total effort is 180 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-12 12 01	Materials for Nanoelectronics and Vacuum Technology	Prof. Richter
Contents and Objectives	The module contains: The materials fundamentals for nanoelectronics and the fundamentals for vacuum technology. Objectives: The students are enabled basing on the knowledge of - the assembly, the properties, the fabrication methods and the structure formation of materials as well as - the effects and the basic types of nanoelectronic structures to conclude the possibilities and the challenges of nanoelectronic material systems. The students are qualified to - derive vacuum technological complexities from the knowledge of the kinetic gas theory, - substantiate adequate pump and pressure reading systems for the different pressure ranges.	
Modes of Teaching and Learning	The module consists of 4 hours per week lectures, 1 hour per week tutorials and self-study.	
Prerequisites		
Usability	The module is an elective module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consists of two written exams in the amount of 90 minutes for each and a collection of practical protocols, if the number of participants exceeds 20. With up to 20 participants, the written exams will be replaced by an oral exam as an individual exam worth 30 minutes. The nature of the specific exams are announced at the end of the registration period as usually known from the faculty.	
Credit Points and Grades	6 credit points can be obtained by the module. The module grade is the both grades of the examinations weighted by 40 % each and the grade of the collection of lab protocols weighted by 20 %.	
Frequency	The module will be offered every winter semester.	
Work Load	The total effort is 180 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-12 12 03	Memory Technology	Prof. Mikolajick
Contents and Objectives	This module covers memory concepts in the market and in research respectively development stage: - Magnatic memories - Optival memories - Semiconductor memories (SRAM, DRAM, nonvolatile Memories (EPROM, EEPROM, Flash)) - Innovative semiconductor memories (e.g. ferroelectric, magnetoresistive, resisitive, organic, and single molecule memories) Qualification goals: After completion of the module the students have the comeptences to optimize and develop new generetions of existing memory concepts. Based on the physical effects they will also be able to devolpe new memory concepts. Furthermore the students are able to evaluate areas of application for the memory concept and are aware of their limitation.	
Modes of Teaching and Learning	The module consists of 4 hours per week lectures, 2 hours per week tutorials and self-study.	
Prerequisites	Requirements are necessary , which can be obtained in the first part of module „Semiconductor Technology“ and in the module „Materials for Nanoelectronics and Vacuum Technology“ for example.	
Usability	The module is an elective module in the master's program "Nanoelectronic Systems" and an elective module in the main study of the degree program "Elektrotechnik".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consists of an oral exam as individual exam worth 25 minutes.	
Credit Points and Grades	7 credit points can be obtained by the module. The module grade is the grade of the examination.	
Frequency	The module will be offered every summer semester.	
Work Load	The total effort is 210 hours.	
Duration	The module takes two semester.	

Module Number	Module Name	Lecturer in Charge
NES-12 08 03	Modeling and Characterization of Electron Devices	Prof. Schröter
Contents and Objectives	The Module encompasses: - Current scientific topics and trends in the area of characterization and modeling of micro- and nanoelectronic devices Objectives: After completing this module, students can solve real-and research-related tasks in the field of modeling and characterization of micro-and nanoelectronic devices independently (including design, documentation and discussion) as well as analyze and interpret test results. Furthermore, they will be capable of incorporating quickly and independently new topics based on research literature.	
Modes of Teaching and Learning	The module consists of 2 hours per week lectures, 2 hours per week tutorials, 2 hours per week practical training and self-study.	
Prerequisites	The following expertises are required: - Analysing and interpreting of realistic electrical characteristics of active microelectronic devices - Describing the behavior of active micro- and nanoelectronic devices employing equivalent circuits and physical (compact-)models Literature: M. Schröter, "Elektronische Bauelemente", Lecture script S.M.Sze,„Physics of Semiconductor Devices"	
Usability	The module is an elective module in the master's programs "Elektrotechnik Mikroelektronik)" and "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consists of a written project report in scope of 80 hours.	
Credit Points and Grades	8 credit points can be obtained by the module. The module grade is the grade of the report.	
Frequency	The module will be offered every summer semester.	
Work Load	The total effort is 240 hours.	
Duration	The module takes two semester.	

Module Number	Module Name	Lecturer in Charge
NES-12 10 05	Modeling and Simulation of Telecommunication Systems	Prof. Lehnert
Contents and Objectives	The module presents the concepts and tools of "Discrete Event Simulation", including methods for generating arbitrarily distributed random variables and the time series analysis of simulation runs including accuracy measures. Outcomes: After completion of the module the students know the principles of performance analysis of communication networks and can handle essential procedures for modeling and performance evaluation. They will be able to select and apply appropriate methods of investigation by simulation for different problems. Students are familiar with the concept of queueing system models and can model real systems correctly. They have acquired basic knowledge of the simulator "ns-3".	
Modes of Teaching and Learning	The module consists of 2 hours per week lectures, 1 hour per week tutorials and self-study.	
Prerequisites	Knowledge of systems theory on bachelor level and the fundamentals of communication networks (e. g. Proakis, Salehi: Communication Systems Engineering, Prentice Hall) are required.	
Usability	The module is an elective module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consits of an oral exam as individual exam worth 30 minutes.	
Credit Points and Grades	4 credit points can be obtained by the module. The module grade is the grade of the examination.	
Frequency	The module will be offered every winter semester.	
Work Load	The total effort is 120 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-13 14 02	Molecular Electronics	Prof. Cuniberti
Contents and Objectives	The students know the basics of molecular electronics with emphasis on: experimental methods, physical effects and theoretical tools, such as single molecule electronics, raster probe and break-junction techniques, transport mechanisms at the nanoscale, molecular components (diodes, transistors, sensors) and molecular architectures. The students know the most important experimental and theoretical methods of investigation of charge transport at the molecular scale.	
Modes of Teaching and Learning	The module consists of 2 hours per week lectures, 2 hours per week tutorials and self-study.	
Prerequisites		
Usability	The module is an elective module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consits of a written exam in the amount of 90 minutes, if the number of participants exceeds 10. With up to 10 participants the written exam will be replaced by an oral exam as individual exam worth 20 minutes. The nature of the specific exam is announced at the end of the registration period as usually known from the faculty.	
Credit Points and Grades	6 credit points can be obtained by the module. The module grade is the grade of the examination.	
Frequency	The module will be offered every winter semester.	
Work Load	The total effort is 180 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-13 14 01	Nanotechnology and Material Science	Prof. Cuniberti
Contents and Objectives	After completing the module the students know the basic physics of nanotechnology and the production and properties of nanostructured materials, including - quantum effects, mesoscopic systems, scaling laws - fabrication of clusters and nanotubes - band structure, density of states, electron transport in low-dimensional solids - theoretical foundations of scanning tunneling microscopy, atomic force microscopy, and optical near-field microscopy - nanostructuring via electron beam lithography, optical lithography, and scanning probe methods - Giant magnetoresistance, single electronic devices	
Modes of Teaching and Learning	The module consists of 4 hours per week lectures, 2 hours per week tutorials, 2 hours per week practical training and self-study.	
Prerequisites	The basics of physics, chemistry, and quantum mechanics	
Usability	The module is an elective module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consists of a written exam in the amount of 90 minutes, if the number of participants exceeds 10 (1st exam) and an oral exam as an individual exam worth 20 minutes (2nd exam). With up to 10 participants the written exam is replaced by an oral exam as individual exam worth 20 minutes (1st exam). The nature of the specific exam is announced at the end of the registration period as usually known from the faculty.	
Credit Points and Grades	12 credit points can be obtained by the module. The module grade follows from the weighted average of the exam grades defined by - 75 % for the first examination - 25 % for the second examination	
Frequency	The module will be offered every summer semester.	
Work Load	The total effort is 360 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-12 12 05	Optoelectronics	Prof. Lakner
Contents and Objectives	Contents: Nano-Optics: - Optical phenomena on the length scale much lower than the diffraction limit of the wavelength λ, e.g. interaction between fluorescent atoms and molecules, optical interaction between molecules and surfaces, but also surface-reinforcing effects. - Usage of nano-optics for novel devices and applications (analysis and characterization). Opto-Electronic Devices and Systems: The principles and technical realization of optoelectronic devices and systems (such as light emitting diodes, laser diodes, compound semiconductors, organic semiconductors, micro-opto-electro-mechanical systems for modulation and deflection of light) and applications of these devices in projection systems, displays, modulators and optical storage. Outcomes: The students know the most important optical phenomena on length scales far below the diffraction limit (etc. bright and non-brihht recombination processes, electric field enhancement at interfaces and surfaces) and understand their application in optical devices and their use in applications. They know how optoelectronic components and systems are implemented and how they are used in applications (e.g. projection systems, displays).	
Modes of Teaching and Learning	The module consists of 4 hours per week lectures, 1 hour per week tutorials and self-study.	
Prerequisites	Basic knowledge about technical optic on bachelor level	
Usability	The module is an elective module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consists of two oral exams as individual exams worth 20 minutes for each.	
Credit Points and Grades	7 credit points can be obtained by the module. The module grade is arithmetic mean of the grades of the examinations.	
Frequency	The module will be offered every winter semester.	
Work Load	The total effort is 210 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-11 06 05	Real-Time Systems	Prof. Härtig
Contents and Objectives	Upon successful completion of the module, students are able to classify, model, and evaluate real-time systems and they can concern oneself in depth with real-time systems. The module covers the basics of load and resource description, time, clocks and clock synchronization, timed vs. event-driven design and scheduling techniques. The students have advanced knowledge to topics such as real-time programming languages (synchronous and event-driven), real-time operating systems, real-time hardware, microcontrollers, caches, real-time communication in field bus systems and wide area networks, and general applications of real-time systems. With this broad knowledge the students have the holistic fundamentals on this subject.	
Modes of Teaching and Learning	The module consists of 2 hours per week lectures, 1 hour per week tutorials and self-study.	
Prerequisites	Basic knowledge on bachelor level in the areas of operating systems, computer architecture and software engineering	
Usability	The module is an elective module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment is an oral exam as individual exam worth 30 minutes.	
Credit Points and Grades	6 credit points can be obtained by the module. The module grade is the grade of the examination.	
Frequency	The module will be offered every winter semester.	
Work Load	The total effort is 180 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-11 06 03	Software Fault-Tolerance	Prof. Fetzer
Contents and Objectives	Graduates of this module are able to develop and to use mechanisms and systems designs, that address on often than the average as software errors occurring system failures in distributed systems at run time. They have the necessary expertise on the subject of forgiveness and use their expertise to discuss and evaluate current scientific work in this area. At the end of the module, the students to have the necessary practical skills with which they can analyze and correct errors in specific application scenarios. They are in a position to use the acquired skills of this module in new, unknown scenarios and apply them to develop effective practical solutions.	
Modes of Teaching and Learning	The module consists of 2 hours per week lectures, 2 hours per week tutorials and self-study.	
Prerequisites	Participants should be familar with the basics of design, development and operation of computer-based systems. (bachelor level)	
Usability	The module is an elective module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consists of an oral exam as individual exam worth 30 minutes. A collection of exercises must be solved as examination requirements.	
Credit Points and Grades	6 credit points can be obtained by the module. The module grade is the grade of the examination.	
Frequency	The module will be offered every summer semester.	
Work Load	The total effort is 180 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-12 09 01	Stochastic Signals and Systems	Prof. Hoffmann
Contents and Objectives	After completion of the module the students master the description methods of stochastic signals as realizations of stochastic processes. They are in a position to calculate the behavior of deterministic and stochastic systems under the condition that the systems handle stochastic processes.	
Modes of Teaching and Learning	The module consists of 2 hours per week lectures, 2 hours of tutorials per week, and self-study.	
Prerequisites	Basics of the theory of deterministic systems and basic knowledge of probability calculus on bachelor level	
Usability	The module is an elective module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment is a written exam in the amount of 90 minutes.	
Credit Points and Grades	6 credit points can be obtained by the module. The module grade is the grade of the examination.	
Frequency	The module will be offered every winter semester.	
Work Load	The total effort is 180 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-11 06 06	Systems Engineering	Prof. Fetzer
Contents and Objectives	After completing this module, students are familar with the basics of design, development and operation of computer-based systems. They have an overview of structures of such systems, which usually consist of several hardware components and several layers of software. The students have the necessary knowledge, especially to non-functional aspects of systems, such as reliability and availability, and control mechanisms for providing these non-functional aspects. The students should be able to understand fundamental relationships of the subject and they can use this knowledge during their further studies.	
Modes of Teaching and Learning	The module consists of 2 hours per week lectures, 2 hours per week tutorials and self-study.	
Prerequisites	Basic knowledge in the areas of system architecture, modularization and structuring of complex systems (on bachelor level).	
Usability	The module is an elective module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consists of a written exam in the amount of 120 minutes. A collection of exercises must be solved as examination requirements.	
Credit Points and Grades	5 credit points can be obtained by the module. The module grade is the grade of the examination.	
Frequency	The module will be offered every winter semester.	
Work Load	The total effort is 150 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-12 08 05	Theory of Nonlinear Networks	Prof. Tetzlaff
Contents and Objectives	After completing this module, students know and apply the basic properties of nonlinear networks and can use important mathematical tools for analysis of networks. Furthermore, the students have knowledge of the structure, properties and applications of cellular nonlinear networks, as well as memristive networks. These two special applications of nonlinear network properties are deeply understood at the end of the course and the students are able to transfer this knowledge also to other networks.	
Modes of Teaching and Learning	The module consists of 3 hours per week lectures, 1 hour per week tutorials and self-study.	
Prerequisites	knowledge of higher mathematics, system theory and circuit design on bachelor level	
Usability	The module is an elective module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consist of a written exam in the amount of 90 minutes.	
Credit Points and Grades	6 credit points can be obtained by the module. The module grade is the grade of the examination.	
Frequency	The module will be offered every winter semester.	
Work Load	The total effort is 180 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-11 06 07	Ubiquitous Information Systems	Prof. Schill
Contents and Objectives	After completing this module, students will be able to classify middleware architectures and platforms for the construction of distributed applications and information systems. This includes the area of mobile communication and mobile processing and the processing in distributed environments. Students can classify and develop concepts and architectures for distributed and ubiquitous application and information systems, select appropriate solutions and evaluate modern technological developments in the art.	
Modes of Teaching and Learning	The module consists of 4 hours per week lectures, 2 hour per week tutorials and self-study.	
Prerequisites	Basic knowledge in the areas of computer networks and operating systems.	
Usability	The module is an elective module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. The module assessment consist of a written exam in the amont of 120 minutes, if the number of participants exceeds 10. With up to 10 participants the written exam is replace by an oral exam as individual exam worth 30 minutes. The nature of the specific exam is announced at the end of the registration period as usually known from the faculty.	
Credit Points and Grades	9 credit points can be obtained by the module. The module grade is the grade of the examination.	
Frequency	The module will be offered every winter semester.	
Work Load	The total effort is 270 hours.	
Duration	The module takes one semester.	

Module Number	Module Name	Lecturer in Charge
NES-11 06 04	Wireless Sensor Networks	Prof. Schill
Contents and Objectives	After successful completion of this module, students are familiar with the fields of ubiquitous computing and wireless sensor and can discuss competent topics such as applications for wireless sensor networks and thier main components. They are aware of the typical aspects of such sensor networks such as energy comsumption, communication, network-level processing and self organisation. They are able to understand and design algorithms for link layer management and media access control in wireless sensor networks. Because a wireless sensor network is a distributed network, the students also master aspects like time synchronization, topology control, and data aggregation. They are familiar with the routing techniques and the request distribution. They can consider und discuss the issues and problems in the field of wireless sensor networks comprehensively.	
Modes of Teaching and Learning	The module consists of 2 hours per week lectures, 2 hours per week tutorials and self-study.	
Prerequisites	Basic knowledge of computer architecture, distributed systems, mobile communication, and software engineering at the Bachelor level is required.	
Usability	The module is an elective module in the master's program "Nanoelectronic Systems".	
Requirements for Acquiring Credit Points	The credit points are awarded when the module assessment is passed. This consists of an individual presentation and of a written axam in the amount of 90 minutes, if the number of participants exceeds 20. With up to 10 participants the witten exam will be replaced by an oral exam as individual exam worth 30 minutes. The nature of the specific exam is announced at the end of the registration period as usually known from the faculty.	
Credit Points and Grades	6 credit points can be obtained by the module. The module grade is the arithmetic mean of the grades of the examinations.	
Frequency	The module will be offered every summer semester.	
Work Load	The total effort is 180 hours.	
Duration	The module takes one semester.	