Module Guide
Master-Programme
IT Engineering
Programme Version 19.0

Wedel, den 22.04.2020
Teil I

Module Guide
Kapitel I.1

Module Guide
Index of Modules by Identifier

M003 Algorithmics ................................................................. 13
M009 Cryptography Workshop .................................................. 16
M014 Modern Production Methods ........................................... 21
M018 Robotics ................................................................. 26
M019 Security Engineering ........................................................ 30
M035 Distributed Systems ........................................................ 32
M037 Dynamical Systems ........................................................ 36
M038 Embedded Systems Workshop ....................................... 39
M040 Project IT Engineering ..................................................... 41
M041 Seminar IT Engineering .................................................... 43
M049 Security Management ..................................................... 45
M059 Medical Engineering ...................................................... 48
M060 Master Thesis ............................................................. 50
M061 Master Colloquium .......................................................... 52
M101 Business Intelligence ....................................................... 54
M115 Technical Optics ............................................................ 57
# Index of Modules by Title

<table>
<thead>
<tr>
<th>Module</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algorithmics</td>
<td>13</td>
</tr>
<tr>
<td>Business Intelligence</td>
<td>54</td>
</tr>
<tr>
<td>Cryptography Workshop</td>
<td>16</td>
</tr>
<tr>
<td>Distributed Systems</td>
<td>32</td>
</tr>
<tr>
<td>Dynamical Systems</td>
<td>36</td>
</tr>
<tr>
<td>Embedded Systems Workshop</td>
<td>39</td>
</tr>
<tr>
<td>Master Colloquium</td>
<td>52</td>
</tr>
<tr>
<td>Master Thesis</td>
<td>50</td>
</tr>
<tr>
<td>Medical Engineering</td>
<td>48</td>
</tr>
<tr>
<td>Modern Production Methods</td>
<td>21</td>
</tr>
<tr>
<td>Project IT Engineering</td>
<td>41</td>
</tr>
<tr>
<td>Robotics</td>
<td>26</td>
</tr>
<tr>
<td>Security Engineering</td>
<td>30</td>
</tr>
<tr>
<td>Security Management</td>
<td>45</td>
</tr>
<tr>
<td>Seminar IT Engineering</td>
<td>43</td>
</tr>
<tr>
<td>Technical Optics</td>
<td>57</td>
</tr>
</tbody>
</table>
1.1.1 Legend to the Module Descriptions

In the following, each module is described in tabular form. The order follows the alphabetical codes.

Preceding the module descriptions there are two directories which support direct access to single descriptions. One directory sorts the descriptions by code, the other by name alphabetically.

The following explanations should make it easier to interpret the entries to the individual fields showing the context in which these entries were made.

Entries for a module

Identifier: Wedel-specific identifier for this module
Name: Name of the module
Course(s): Courses contained in the module with their code and name
Examination: Semester in which the module should be taken assuming a regular course of study
Authority: The strategic tasks of the person in charge of the module comprise of
- synergetic use of the module also in other study programmes
- initiating advancements of the module and its parts
- quality management (e.g. relevance to the programme, workload)

The operative tasks of the module leader comprise in particular of
- coordination of dates for courses and exams.
- initiating and updating the module and course descriptions.
- merging different parts of the exams, collecting the results in tight cooperation with all teachers of the module.
- being the contact person for the students in all questions related to the module.

Curricula: List of all study programmes containing this module
Lessons per Week: Sum of the lessons of all courses contained in this module.
Credits: Sum of credits that can be earned in the courses of this module
Student Workload: The total workload is the number of credits multiplied with 30 hours. The contact time is computed from the lessons per week using the formula 1 lesson = 37.5 minutes. The individual study time is the difference between total workload and contact time.
<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prerequisites</td>
<td>Modules, courses and skills that are required at the beginning of the module. If a course is required, the corresponding module is mentioned.</td>
</tr>
<tr>
<td>Duration</td>
<td>Number of semesters needed to complete this module</td>
</tr>
<tr>
<td>Frequency</td>
<td>Indicates how often the module is offered per year (every semester or every year)</td>
</tr>
<tr>
<td>Assessment</td>
<td>List of all types of assessments which are used in some course of the module</td>
</tr>
<tr>
<td>Language</td>
<td>In this curriculum all courses are offered in English unconditionally. This applies to courses also used in German study programmes, too. In the other study programmes the courses are offered in German by default. However, some courses are eligible to be taught in English if at least one student of an international partner university is enrolled. Such courses are also listed on a special website in order to allow students of the partner universities to choose a course at home already.</td>
</tr>
<tr>
<td>Learning Goals</td>
<td>High level goals referring to the competences to be acquired summarising the individual targets of the course(s)</td>
</tr>
<tr>
<td>Applications</td>
<td>Description of exemplary opportunities for practical applications of the module’s learning goals</td>
</tr>
</tbody>
</table>
Entries for a course

Course: Name of this course
Lecturer(s): Name(s) of the teachers involved in this course
Recommended Semester: Number of semester in which this course should be attended according to the regular course of studies
Course Type: Compulsory or elected, according to the study programme
Teaching Methods: List of all teaching methods applied.
Credits: Credits to be earned by attendance of this course
Teaching Style: List of all teaching styles applied in this course
Learning Goals: Keywords of the central learning goals of this course
Topics: Structured list of the essential topics covered in this course
References: List of the basic references recommended to the students for reviewing and deepening the essential topics. The list of references actually used may be broader.
I.1.2 Algorithmics

M003 Algorithmics

Curriculum: Master study programme IT Engineering
Identifier: M003
Name: Algorithmics
Course(s): M003a Algorithmics
Authority: Prof. Dr. Sebastian Iwanowski
Curricula: Computer Science (Master), IT Engineering (Master)

Applications: The module is a starting module. It sets the theoretical fundamentals for a scientific IT oriented study. It covers the knowledge about fundamental algorithms that are necessary for the solution of various application problems.

Lessons per Week: 4
Credits: 5.0
Prerequisites: Understanding basic mathematical concepts such as definitions, theorems and proofs. Ability of logically sound formulation. The students must be able to follow proofs from the beginning of this course. Required is excellent knowledge of the basics of discrete mathematics, specially in number theory and graph theory. The students must have good programming knowledge and experience in implementing basic algorithms.

Duration: 1

Learning Goals:
The students know how to evaluate the efficiency of algorithms with theoretically sound methods. For selected application domains, they know how to describe algorithms in detail, show examples and implement them. They are able to solve basic proofs for efficiency and correctness on their own. They can understand even complicated proofs and explain them to other people.
1.1.2.1 Algorithmics

Course: Algorithmics  
Lecturer(s): Sebastian Iwanowski  
Recommended Semester: 2  
Frequency: annually  
Course Type: 2  
Teaching Methods: lecture with tutorial, workshop, assignment  
Lessons per Week: 4  
ECTS: 5.0  
Examination: written or oral examination  
Language: English  
Teaching Style: blackboard, handout, overhead slide presentation, software presentation

Learning Goals
The students …

- know the fundamental problems of algorithmics and the classical solving methods.
- are able to analyse the correctness and efficiency of algorithms.
- have detailed knowledge of advanced algorithms for miscellaneous problems in selected application domains.
- know how to implement theoretical results in practical applications.

Topics

- Introduction into formal algorithmics
  - Comparing basic sorting techniques
  - Complexity measures for the analysis of algorithms
  - Lower bound for algorithms using comparisons only
- Advanced searching and sorting
  - Order statistics
  - Searching in sorted arrays
  - Sorting in finite domains
- Solutions for the dictionary problem
  - Hashing and other methods for optimising the average case behaviour
  - (2,3)-trees as example for an optimal worst case behaviour tree
  - Other optimal worst case methods for search trees
  - Optimal binary search trees (Bellman)
• Graph algorithms
  – Minimum spanning trees as motivation for basic algorithms
  – Shortest paths (Dijkstra, Floyd-Warshall, streets)
  – Computation of maximum flows in s/t-networks (Ford-Fulkerson, Edmonds-Karp, Dinic)
  – Computation of graph matchings (bipartite, Edmonds)
• String matching
• Fundamentals of algorithmic geometry
  – Basic problems and the use of Voronoi diagrams for solving them
  – Sweep techniques (including computation of Voronoi diagrams)

References
# I.1.3 Cryptography Workshop

<table>
<thead>
<tr>
<th><strong>Curriculum</strong></th>
<th>Master study programme IT Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Identifier</strong></td>
<td>M009</td>
</tr>
<tr>
<td><strong>Name</strong></td>
<td>Cryptography Workshop</td>
</tr>
<tr>
<td><strong>Course(s)</strong></td>
<td>M009a Cryptography Workshop</td>
</tr>
<tr>
<td></td>
<td>M009a Cryptography Workshop</td>
</tr>
<tr>
<td><strong>Authority</strong></td>
<td>Prof. Dr. Gerd Beuster</td>
</tr>
<tr>
<td><strong>Curricula</strong></td>
<td>Computer Science (Master)</td>
</tr>
<tr>
<td></td>
<td>IT Engineering (Master)</td>
</tr>
<tr>
<td></td>
<td>IT Security (Master)</td>
</tr>
<tr>
<td><strong>Applications</strong></td>
<td>For this module, basic knowledge of discrete mathematics is required. The students acquire advanced knowledge about the mathematical basis of cryptography and its practical application. This knowledge can be utilized in all fields where cryptography methods are used.</td>
</tr>
<tr>
<td><strong>Lessons per Week</strong></td>
<td>8</td>
</tr>
<tr>
<td><strong>Credits</strong></td>
<td>10.0</td>
</tr>
<tr>
<td><strong>Prerequisites</strong></td>
<td>Students need the knowledge about discrete mathematics typically acquired in an undergraduate study programs in computer science or a similar field. Students must be familiar with the common Internet protocols. Students must have some basic knowledge in programming.</td>
</tr>
<tr>
<td><strong>Duration</strong></td>
<td>1</td>
</tr>
</tbody>
</table>

**Learning Goals**

In the cryptography workshop, students gain knowledge about the mathematical base of cryptography and its practical application. After completing the course, students are able to use cryptographic methods in the context of secure IT systems, and to evaluate the use of cryptographic methods in existing systems.

This covers both software- and hardware-based cryptography. A focus is put on cryptography used on the Internet and for E-Commerce. The students know how to ensure the confidentiality and integrity of personal data and business data by cryptographic means. Based on real world cryptographic systems, students learned that many side conditions have to be taken into account when implementing and using cryptographic methods.
I.1.3.1 Cryptography Workshop

Course: Cryptography Workshop
Lecturer(s): Gerd Beuster
Recommended Semester: 2
Frequency: annually
Course Type: workshop
Lessons per Week: 4
ECTS: 5.0
Examination: acceptance test
Language: English
Teaching Style: E-Learning, software presentation, student computer exercises

Learning Goals
After completing the module, students are able to …

- use security tools as an essential building block of modern information and communication systems.
- apply their knowledge of all relevant aspects of data, network and web security.
- assess the application of cryptographic methods, especially for authentication, encryption and integrity preservation.
- assess their algorithmic strengths and weaknesses of cryptographic methods.
- assess and implement cryptographic protocols, especially for authentication in e-commerce.
- consider all side conditions relevant for implementation and application of cryptographic methods.
- assess the quality of random number generators.
- assess the suitability of software and hardware cryptography for a given task.

Topics
- Theory of Cryptography
  - semantic security
  - Unbreakable Encryption and One Time Pad
  - Diffusion and Confusion
- classic cryptography
  - Substitution and Transposition
  - Affine Encryption
  - Rotor Machines
• modern cryptography
  – Stream and Block Ciphers
  – DES and GOST
  – AES

• Block Cipher Modes of Operation
  – ECB, CBC, CTR, AES-GCM

• Random number generators
  – TRNG and PRNG
  – Requirements for CSPRNG
  – PRNG based on mathematical problems
    * Blum Blum Shub

• hashing
  – Hashing Algorithms
    * SHA 2
    * Keccak
  – Message authentication
    * CMAC and HMAC

• asymmetric cryptography
  – Diffie-Hellman
  – RSA
  – elliptic curves
  – Asymmetric Encryption and Digital Signatures

• Practical Cryptography: PGP and SSL

• hardware cryptography
  – trusted computing
  – smart cards
  – Differential Power Analysis

References
I.1.3.2 Cryptography Workshop

Course: Cryptography Workshop
Lecturer(s): Gerd Beuster
Recommended Semester: 2
Frequency: annually
Course Type: 2
Teaching Methods: workshop
Lessons per Week: 4
ECTS: 5.0
Examination: acceptance test
Language: english
Teaching Style: E-Learning, software presentation, student computer exercises

Learning Goals

After completing the module, students are able to ...

- use security tools as an essential building block of modern information and communication systems.
- apply their knowledge of all relevant aspects of data, network and web security.
- assess the application of cryptographic methods, especially for authentication, encryption and integrity preservation.
- assess their algorithmic strengths and weaknesses of cryptographic methods.
- assess and implement cryptographic protocols, especially for authentication in e-commerce.
- consider all side conditions relevant for implementation and application of cryptographic methods.
- assess the quality of random number generators.
- assess the suitability of software and hardware cryptography for a given task.

Topics

- Theory of Cryptography
  - semantic security
  - Unbreakable Encryption and One Time Pad
  - Diffusion and Confusion
- classic cryptography
  - Substitution and Transposition
  - Affine Encryption
  - Rotor Machines
• modern cryptography
  – Stream and Block Ciphers
  – DES and GOST
  – AES
• Block Cipher Modes of Operation
  – ECB, CBC, CTR, AES-GCM
• Random number generators
  – TRNG and PRNG
  – Requirements for CSPRNG
  – PRNG based on mathematical problems
    * Blum Blum Shub
• hashing
  – Hashing Algorithms
    * SHA 2
    * Keccak
  – Message authentication
    * CMAC and HMAC
• asymmetric cryptography
  – Diffie-Hellman
  – RSA
  – elliptic curves
  – Asymmetric Encryption and Digital Signatures
• Practical Cryptography: PGP and SSL
• hardware cryptography
  – trusted computing
  – smart cards
  – Differential Power Analysis

References
I.1.4 Modern Production Methods

M014 Modern Production Methods

Curriculum
Master study programme IT Engineering

Identifier
M014

Name
Modern Production Methods

Course(s)
M014b Laser Engineering
M014a Fiber reinforced plastics and hybrids (FRP)

Authority
Prof. Dr. Ioana Serban

Curricula
IT Engineering (Master)
Management and Engineering (Master)

Applications
No addictions.

Lessons per Week
4

Credits
5.0

Prerequisites
Basic knowledge of chemistry, materials science and physics, in particular electromagnetic waves and atomic physics.

Duration
1

Learning Goals

In the first part of the module, students learn about modern production processes for processing plastics and elastomers. The students should be able to recognize and name the applied manufacturing processes on the basis of a concrete product. Manufacturing processes are assessed both from a technological and an economic point of view. Students will be able to analyse the requirements of a product for a suitable manufacturing process, select appropriate manufacturing processes and develop new process chains.

In the second part the students get to know the basic physical principles of a laser system. You can name and explain these principles accordingly.

The suitability of the laser as a tool in manufacturing is highlighted and distinguished from other manufacturing processes.

The students are able to assign different production requirements to the treated laser systems and are able to make the decision about the selection of a laser system for a concrete production project.
1.1.4.1 Laser Engineering

Course Laser Engineering
Lecturer(s) Ioana Serban
Recommended Semester 2
Frequency annually
Course Type 2
Teaching Methods lecture
Lessons per Week 2
ECTS 2.5
Examination written or oral examination
Language english
Teaching Style blackboard, projector presentation

Learning Goals
After successful completion of this module, students are able to ...

- name and explain the modern production methods for plastics, elastomers and composite materials
- recognize the employed production methods of finished products
- evaluate production methods according to technological and economical aspects
- analyze the demands a product poses for a production method, select corresponding production methods and develop new process chains
- name and explain the physical principles of the laser
- expose the advantages of lasers as production tools and show differences to other methods
- assign different production demands to different laser systems.

Topics
- physical principles
  - electromagnetic radiation
  - elements of atomic physics
  - interaction of light and matter
- laser physics
  - light amplification, population inversion
  - first laser condition
  - dynamics
- laser resonators
  - mirror resonators
- stability
- second laser condition
- resonator modes (longitudinal, transversal)

- laser pulses
  - q-switching
  - fashion coupling

- laser systems
  - distinction of different active media
  - properties of special laser systems

- technological applications

References
### 1.1.4.2 Fiber reinforced plastics and hybrids (FRP)

<table>
<thead>
<tr>
<th>Course</th>
<th>Fiber reinforced plastics and hybrids (FRP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecturer(s)</td>
<td>Hauke Lengsfeld</td>
</tr>
<tr>
<td>Recommended Semester</td>
<td>2</td>
</tr>
<tr>
<td>Frequency</td>
<td>annually</td>
</tr>
<tr>
<td>Course Type</td>
<td>2</td>
</tr>
<tr>
<td>Teaching Methods</td>
<td>lecture</td>
</tr>
<tr>
<td>Lessons per Week</td>
<td>2</td>
</tr>
<tr>
<td>ECTS</td>
<td>2.5</td>
</tr>
<tr>
<td>Examination</td>
<td>written or oral examination</td>
</tr>
<tr>
<td>Language</td>
<td>english</td>
</tr>
<tr>
<td>Teaching Style</td>
<td>blackboard, projector presentation</td>
</tr>
</tbody>
</table>

**Learning Goals**

The students gain …

- knowledge of FRPs and lightweight materials properties.
- knowledge of manufacturing and assembling technologies.
- basic knowledge of manufacturing engineering and design principles of FRP parts.
- basic skills to assess manufacturing processes from a technical and economical position.

**Topics**

- basic knowledge of
  - properties of typical fibers and reinforcements
  - semi-finished products: textiles, prepregs
  - manufacturing of fibers and textiles
  - requirements and properties of matrix materials
- engineering with FRPs
  - properties of FRPs, differences to metals
  - engineering design principles with FRPs
  - manufacturing friendly part design
- processing and part manufacturing with FRPs
  - processing and manufacturing technologies
  - processing of semi-finished products (textiles, matrix, prepregs)
  - postprocessing (milling, drilling) of FRP parts
  - assembling technologies of FRP parts
  - recycling
• applications of FRP parts
  – space & aeronautics
  – automotive
  – wind energy & industry

References
I.1.5 Robotics

M018 Robotics

Curriculum  Master study programme IT Engineering
Identifier    M018
Name           Robotics
Course(s)     M018a Robotics
Authority     Prof. Dr. Ulrich Hoffmann
Curricula     Computer Science (Master)
                 IT Engineering (Master)
Applications  The module is reasonably combined with the basic modules “Introduction to Robotics” and “Image Processing and Analysis” as well as the module “Learning & Softcomputing”. It can be used in all technical degree programs.
Lessons per Week  4
Credits  5.0
Prerequisites  Prerequisites are the comprehensive understanding of information technology and software engineering concepts. These are best achieved by a previous studies of computer science or IT engineering with focus on media technology or computer architecture. These studies should have established a bachelor of science in computer science degree. It is assumed that students will be able to work independently in a scientific environment.
Duration  1

Learning Goals

Students earn fundamental competence in selected robot concepts and technologies.

One focus is to perculate the properties of mobile and autonomous systems. Starting with the basic foundation of robotics topics students will gain experience in motion and action modelling concepts as well as intelligent learning sensors as basis of autonomous robot behavior.

A showcase implementation within a self-organized group oriented project of one of the theoretically presented concepts enhances the understanding of the concepts at hand.
Students especially achieve a thorough understanding and can categorize and rate practical problems that arise in robot actions guided by visual image processing.

In addition the project leads to an improved presentation style and presentation technique as well as enhanced abilities to freely discuss complex scientific situations in a team.
I.1.5.1 Robotics

Course: Robotics
Lecturer(s): Ulrich Hoffmann
Recommended Semester: 2
Frequency: annually
Course Type: 2
Teaching Methods: different types of lectures
Lessons per Week: 4
ECTS: 5.0
Examination: assessment
Language: english
Teaching Style

Learning Goals

- have basic knowledge of selected concepts and technologies of robotics.
- thoroughly understand mainly properties of mobile autonomous systems.
- have a deep understanding of the technical foundation of robotics and especially of the concepts of movement and action modeling as well as intelligent learning sensors as basis of autonomous robot behavior.
- are able to realize show case implementations of presented theoretical concepts in a self organized and group oriented project.
- have the competence to understand practical problems that occur when robot actions are guided by visual images.
- are able to convey comprehensibly their scientific results in an appropriate presentation with suitable presentation techniques.
- have the capability to communicate complex scientific facts in a technical discussion in a competent way.

Topics

- Structure and composition of robots
  - kinematics
  - Motion and movers
  - effectors
  - Programming systems
- motion modeling
  - Point to point control
  - Interpolation of trajectories
• Action modeling
• Intelligent sensors
  – Tactile sensors
  – Optical sensors
• Learning robots
• Practical project in groups in order to self-dependently implement and study a given complex topic area.
• Regular discussion of project results and presentations in groups.

References
## I.1.6 Security Engineering

**M019 Security Engineering**

<table>
<thead>
<tr>
<th><strong>Curriculum</strong></th>
<th>Master study programme IT Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Identifier</strong></td>
<td>M019</td>
</tr>
<tr>
<td><strong>Name</strong></td>
<td>Security Engineering</td>
</tr>
<tr>
<td><strong>Course(s)</strong></td>
<td>M019a Security Engineering</td>
</tr>
<tr>
<td><strong>Authority</strong></td>
<td>Prof. Dr. Gerd Beuster</td>
</tr>
<tr>
<td><strong>Curricula</strong></td>
<td>IT Engineering (Master)</td>
</tr>
<tr>
<td></td>
<td>IT Security (Master)</td>
</tr>
<tr>
<td><strong>Applications</strong></td>
<td>The module requires basic knowledge in the fields of computer architecture, operating systems, computer networks, and programming. The skills acquired in this module are applicable to all tasks involving software and security engineering.</td>
</tr>
<tr>
<td><strong>Lessons per Week</strong></td>
<td>4</td>
</tr>
<tr>
<td><strong>Credits</strong></td>
<td>5.0</td>
</tr>
<tr>
<td><strong>Prerequisites</strong></td>
<td>Students must be able to think analytically and to build formal methods. These abilities are typically acquired in an undergraduate study programs in computer science or a similar field. In addition, students must know the general principals of modern computers and operating systems, network technology, and programming.</td>
</tr>
<tr>
<td><strong>Duration</strong></td>
<td>1</td>
</tr>
</tbody>
</table>

### Learning Goals

After completing the module, the students are able to evaluate the security of existing IT systems and to design and implement new, secure IT systems. This module focuses on the engineering aspects of IT security. When the module is completed, the students know the state of the art in secure software, secure hardware, network security and physical security. The students are able to design systems providing adequate security both for personal and business data.
### 1.1.6.1 Security Engineering

<table>
<thead>
<tr>
<th>Course</th>
<th>Security Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecturer(s)</td>
<td>Gerd Beuster</td>
</tr>
<tr>
<td>Recommended Semester</td>
<td>2</td>
</tr>
<tr>
<td>Frequency</td>
<td>annually</td>
</tr>
<tr>
<td>Course Type</td>
<td>2</td>
</tr>
<tr>
<td>Teaching Methods</td>
<td>lecture with tutorial, workshop, assignment</td>
</tr>
<tr>
<td>Lessons per Week</td>
<td>4</td>
</tr>
<tr>
<td>ECTS</td>
<td>5.0</td>
</tr>
<tr>
<td>Examination</td>
<td>written or oral examination</td>
</tr>
<tr>
<td>Language</td>
<td>english</td>
</tr>
<tr>
<td>Teaching Style</td>
<td>E-Learning, interactive development and discussion of models, software presentation, student computer exercises</td>
</tr>
</tbody>
</table>

#### Learning Goals

After completing the module, students are able to ...

- apply the basic concepts of IT Security.
- define and check security requirements for software.
- develop and evaluate secure software.
- assess and evaluate the security of hardware components.
- evaluate the security of computer networks.
- design secure computer networks.

#### Topics

- Basic Concepts of IT Security
- threat modeling
- Threats in Practice
- security modeling
- Security Administration and Physical Security
- Operating System Security and Access Rights
- security protocols
- Methods for Developing Secure Software
- Typical Attacks on Software Systems
- Distributed Systems / Network Security
- Secure Hardware

#### References
## I.1.7 Distributed Systems

<table>
<thead>
<tr>
<th>Curriculum</th>
<th>Master study programme IT Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifier</td>
<td>M035</td>
</tr>
<tr>
<td>Name</td>
<td>Distributed Systems</td>
</tr>
<tr>
<td>Course(s)</td>
<td>M035a Distributed Systems</td>
</tr>
<tr>
<td></td>
<td>M035b Tutorial: Distributed Systems</td>
</tr>
<tr>
<td>Authority</td>
<td>Prof. Dr. Ulrich Hoffmann</td>
</tr>
<tr>
<td>Curricula</td>
<td>Computer Science (Master)</td>
</tr>
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<td>IT Engineering (Master)</td>
</tr>
<tr>
<td></td>
<td>IT Security (Master)</td>
</tr>
<tr>
<td>Applications</td>
<td>The module can well be combined with modules “Functional Programming” and “Current Developments in Computer Science” as well as with the “Seminar Master”.</td>
</tr>
<tr>
<td>Lessons per Week</td>
<td>4</td>
</tr>
<tr>
<td>Credits</td>
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</tr>
<tr>
<td>Prerequisites</td>
<td>The practical exercises assume advanced programming abilities. In addition the module assume solid knowledge of internet architecture and structure as well as basic knowledge of enterprise workflow process organization.</td>
</tr>
<tr>
<td>Duration</td>
<td>1</td>
</tr>
</tbody>
</table>

### Learning Goals

Students gain extended knowledge of technical aspects of distributed systems as well as their area of applications in commercial contexts. They experience and discuss technological inherent problems of distributed systems and thus have the ability to address the challenges of distributed system and to copy with them. They know the architecture and major algorithms in distributed systems as well as processes in development and administration that lead to successful distributed products. They are able to program distributed systems in different program paradigms.
I.1.7.1 Distributed Systems

<table>
<thead>
<tr>
<th>Course</th>
<th>Distributed Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecturer(s)</td>
<td>Ulrich Hoffmann</td>
</tr>
<tr>
<td>Recommended Semester</td>
<td>1</td>
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<tr>
<td>Frequency</td>
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<td>Course Type</td>
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<td>Lessons per Week</td>
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<td>ECTS</td>
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<tr>
<td>Examination</td>
<td>written or oral examination</td>
</tr>
<tr>
<td>Language</td>
<td>english</td>
</tr>
</tbody>
</table>

Teaching Style

Learning Goals

The students gain ...

- thorough understanding of principles of distributed applications.
- knowledge in mastering base technologies and current software tools for distributes systems.
- knowledge of state of the are in different application areas such as service mediation and e-commerce.
- knowledge of basic algorithms in distributed systems.
- precise knowledge of current web service architectures.
- practical skills to realize a project.
- distributed programming skills in different paradigms.

Topics

- practical examples
- general requirements of distributed systems
- the client server relation and resulting questions
- communications in distributed systems
- naming services
- techniques for concurrency
- remote calls
- alternative paradigms (actor concept, \ldots )
- synchronization of data and processes
- coordination methods
- replication techniques
- WEB services with SOAP and REST
- fault tolerance concepts
- security in distributed systems
- programming with threads
- communication via sockets, structure of clients and servers
- remote procedure call / remote method invocation
- using naming services
- programming WEB services (SOAP, server / client, WSDL, data binding)
- distributed programming with alternate concepts
- programming synchronization algorithms
- programming distributed election algorithms
- programming of REST based services and clients
- fault tolerant programming in distributed systems

References
I.1.7.2 Tutorial: Distributed Systems

Course 
Tutorial: Distributed Systems

Lecturer(s) 
Ulrich Hoffmann

Recommended Semester 
1

Frequency 
anually

Course Type 
1

Teaching Methods 
tutorial/lab/business game

Lessons per Week 
2

ECTS 
2.0

Examination 
acceptance test

Language 
english

Teaching Style

Learning Goals

The students …

- have the ability to operate typical software systems (middleware) in the area of distributed systems and use them to solve problems.

- are accustomed to problems that occur in reality and are able to overcome these.

- have deep knowledge of the specific properties of distributed systems by practical experience. They can categorize and evaluate these properties.

Topics

Lecture accompanying practical exercises in programming distributed systems and their algorithms in different programming paradigms.

References
## 1.1.8 Dynamical Systems

<table>
<thead>
<tr>
<th><strong>Curriculum</strong></th>
<th>Master study programme IT Engineering</th>
</tr>
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<tbody>
<tr>
<td><strong>Identifier</strong></td>
<td>M037</td>
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<td><strong>Name</strong></td>
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<td><strong>Course(s)</strong></td>
<td>M037a Digital Feedback Control</td>
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<tr>
<td><strong>Authority</strong></td>
<td>Prof. Dr.-Ing. Carsten Burmeister</td>
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<tr>
<td><strong>Curricula</strong></td>
<td>IT Engineering (Master)</td>
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<tr>
<td><strong>Applications</strong></td>
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<td><strong>Lessons per Week</strong></td>
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<td><strong>Credits</strong></td>
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**Learning Goals**

für diesen Textabschnitt zuständige Mitarbeiter konnte die angeforderten Inhalte leider nicht rechtzeitig liefern.
I.1.8.1 Digital Feedback Control

Course Digital Feedback Control
Lecturer(s) Carsten Burmeister
Recommended Semester 1
Frequency annually
Course Type 1
Teaching Methods lecture
Lessons per Week 2
ECTS 2.5
Examination written or oral examination
Language english
Teaching Style

Learning Goals

Topics

References
## 1.1.8.2 Dynamical Systems

<table>
<thead>
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<td>Carsten Burmeister</td>
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<td>Lessons per Week</td>
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</table>

**Teaching Style**

**Learning Goals**

**Topics**

**References**
I.1.9 Embedded Systems Workshop

M038 Embedded Systems Workshop

Curriculum  
Master study programme IT Engineering

Identifier  
M038

Name  
Embedded Systems Workshop

Course(s)  
M038a Embedded Systems Workshop

Authority  
Dipl.-Ing. (FH) Timm Bostelmann

Curricula  
IT Engineering (Master)

Applications  
This module fits in with other modules covering hardware and software engineering.

Lessons per Week  
6

Credits  
5.0

Prerequisites  
Knowledge of electronics engineering and system programming

Duration  
1

Learning Goals

The students know how to engineer a prototype of an embedded system based on a functional specification. Furthermore they are able to perform methodical tests and create a technical documentation. The students are able to utilize data-sheets to read up on complex components like micro-controllers and embedded sensors. They can engineer embedded hardware and handle the specific demands of embedded software development.
I.1.9.1 Embedded Systems Workshop

Course: Embedded Systems Workshop
Lecturer(s): Timm Bostelmann
Recommended Semester: 1
Frequency: annually
Course Type: 1
Teaching Methods: workshop
Lessons per Week: 6
ECTS: 5.0
Examination: acceptance test
Language: english
Teaching Style: blackboard, handout, projector presentation, software presentation, student computer exercises

Learning Goals
The students are able to ...

- engineer a prototype of an embedded system based on a functional specification.
- understand and utilize data-sheets.
- read up on complex components like micro-controllers and embedded sensors.
- engineer analogue and digital interface hardware for an embedded system (depending on the workshop topic).
- engineer embedded software.
- create a technical documentation.

Topics
- Introduction to embedded systems.
  - Embedded system engineering
  - Embedded hardware engineering
  - Embedded software engineering
- Introduction to the laboratory equipment.
- Guided engineering of a simple embedded system.
- Engineering, testing and documentation of an embedded system prototype.

References
### I.1.10 Project IT Engineering

<table>
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<td><strong>Curricula</strong></td>
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**Learning Goals**

für diesen Textabschnitt zuständige Mitarbeiter konnte die angeforderten Inhalte leider nicht rechtzeitig liefern.
## I.1.10.1 IT Engineering Project

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<td>Teaching Methods</td>
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<td>Teaching Style</td>
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### Learning Goals

### Topics

### References
### I.1.11 Seminar IT Engineering

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<tr>
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<td>Course(s)</td>
<td>M041a Seminar IT Engineering</td>
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<tr>
<td>Authority</td>
<td>Prof. Dr. Sebastian Iwanowski</td>
</tr>
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<td>Curricula</td>
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<td>Prerequisites</td>
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**Learning Goals**

🎉 für diesen Textabschnitt zuständige Mitarbeiter konnte die angeforderten Inhalte leider nicht rechtzeitig liefern.
I.11.11.1 Seminar IT Engineering

**Course**
Seminar IT Engineering

**Lecturer(s)**
jeweiliger Dozent

**Recommended Semester**
1

**Frequency**
every semester

**Course Type**
1

**Teaching Methods**
seminar

**Lessons per Week**
2

**ECTS**
5.0

**Examination**
written documentation (if necessary presentation)

**Language**
english

**Teaching Style**
blackboard, handout, overhead slide presentation, software presentation

**Learning Goals**

**Topics**

**References**
I.1.12 Security Management

M049 Security Management

Curriculum: Master study programme IT Engineering
Identifier: M049
Name: Security Management
Course(s): M049a Security Management
Authority: Prof. Dr. Gerd Beuster
Curricula: Business Studies (Master)
IT Engineering (Master)
IT Security (Master)
Management and Engineering (Master)

Applications: The module does not require specific knowledge, but general analytical thinking and modelling skills are required. The knowledge acquired in the module can be used both in the area of security management and in other management areas, in particular in quality management.

Lessons per Week: 4
Credits: 5.0
Prerequisites: Students need the analytical thinking and modelling skills acquired in a bachelor’s degree in computer science or similar studies.

Duration: 1

Learning Goals
In the Security Management module, students learn to evaluate and design IT security in the context of corporate strategies. Students learn to understand security as a holistic concept that not only has software, but also hardware as well as administrative and physical aspects. After completing the module, they will be familiar with the legal and private sector standards for safety evaluation and certification. You can create and implement security concepts and policies. They are familiar with the basic concepts of data protection in the national and international context. Students are taught the ability to take on management tasks in the field of IT security and to work as IT security managers. They are in a position to identify goods worth protecting in a company and to develop and implement the administrative measures necessary for protection. The students know the interfaces to and overlaps with other areas of management, in particular IT management and change management.
I.1.12.1 Security Management

Course
Security Management

Lecturer(s)
Gerd Beuster

Recommended Semester
1

Frequency
annually

Course Type
1

Teaching Methods
lecture with tutorial, workshop, assignment

Lessons per Week
4

ECTS
5.0

Examination
written or oral examination

Language
deutsch/englisch

Teaching Style
E-Learning, interactive development and discussion of models, software presentation

Learning Goals

Sie erlangen die ...

- Fähigkeit, Bedrohungen zu identifizieren und zu modellieren.
- Fähigkeit, Risiken zu bewerten.
- Fähigkeit, die Angemessenheit von Sicherheitsmaßnahmen zu bewerten und angemessene Sicherheitsmaßnahmen zu konzipieren.
- Kenntnis der relevanten Standards und Zertifizierungsschemata im Bereich der IT-Sicherheit
- Fähigkeit, IT-Sicherheit im Zusammenspiel mit organisatorischen und physischen Sicherheitsanforderungen und -maßnahmen zu gewährleisten
- Kenntnisse der Zusammenhänge zwischen Sicherheits- und Qualitätsmanagement

Fähigkeit, Bedrohungen zu identifizieren und zu modellieren.
Fähigkeit, Risiken zu bewerten.
Fähigkeit, die Angemessenheit von Sicherheitsmaßnahmen zu bewerten und angemessene Sicherheitsmaßnahmen zu konzipieren.
Kenntnis der relevanten Standards und Zertifizierungsschemata im Bereich der IT-Sicherheit
Fähigkeit, IT-Sicherheit im Zusammenspiel mit organisatorischen und physischen Sicherheitsanforderungen und -maßnahmen zu gewährleisten
Kenntnisse der Zusammenhänge zwischen Sicherheits- und Qualitätsmanagement

Topics

- Einführung in das IT-Security-Management
- Unternehmenssicherheit als ökonomischer Faktor
- Angreifer und Angriffsziele
- Management sicherheitskritischer IT-Projekte
- IT-Grundschutz
- Evaluierungs- und Zertifizierungsschemata in der IT-Sicherheit
- data protection
- safety training
- Physikalische Sicherheit
- Sicherheitsaudits und Revisionskontrolle
- Sicherheitsmanagement und Qualitätsmanagement

Einführung in das IT-Security-Management
Unternehmenssicherheit als ökonomischer Faktor
Angreifer und Angriffsziele
Management sicherheitskritischer IT-Projekte
IT-Grundschutz
Evaluierungs- und Zertifizierungsschemata in der IT-Sicherheit
data protection
safety training
Physikalische Sicherheit
Sicherheitsaudits und Revisionskontrolle
Sicherheitsmanagement und Qualitätsmanagement

References
I.1.13 Medical Engineering

M059 Medical Engineering

<table>
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<th>Master study programme IT Engineering</th>
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<tr>
<td>Identifier</td>
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<tr>
<td>Name</td>
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<td>Course(s)</td>
<td>M059a Medical Engineering</td>
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<tr>
<td>Authority</td>
<td>PD Dr. Dennis Säring</td>
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<td>Curricula</td>
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<td>Prerequisites</td>
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<td></td>
<td>Basics in Programming</td>
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<td>Duration</td>
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</table>

Learning Goals

Medical Datasets and Information
- Where can Computer Science help in medicine?
- Patient records and clinical documentation
- Coding and Diagnosis Related Groups

Medical Imaging
- Working Principle And Algorithms For Image Acquisition (EEG, US, CT, MRI, Nuclear Medicine)

Medical Image Processing
- Working principles of image pre-processing
- Basics about image segmentation and image analysis
I.1.13.1 Medical Engineering

Course: Medical Engineering
Lecturer(s): Dennis Säring
Recommended Semester: 1
Frequency: annually
Course Type: 1
Teaching Methods: lecture
Lessons per Week: 4
ECTS: 5.0
Examination: written or oral examination
Language: english
Teaching Style: E-Learning

Learning Goals
Medical Datasets and Information
- Where can Computer Science help in medicine?
- Patient records and clinical documentation
- Coding and Diagnosis Related Groups

Medical Imaging
- Working Principle And Algorithms For Image Acquisition (EEG, US, CT, MRI, Nuclear Medicine)

Medical Image Processing
- Working principles of image pre-processing
- Basics about image segmentation and image analysis

Topics
Students
- shall understand the importance of the fields of engineering and computer science for medicine.
- shall understand that designing and approving medical devices.
- will learn to understand the different physical working principles and main algorithms used for different medical imaging devices such as Ultrasonography, Electroencephalography, X-ray Computed Tomography and Magnetic Resonance Imaging
- will learn some basics in medical image processing

References
not specified
## I.1.14 Master Thesis

<table>
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<td><strong>Name</strong></td>
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<tr>
<td><strong>Authority</strong></td>
<td>jeweiliger Dozent</td>
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<td><strong>Applications</strong></td>
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<td><strong>Credits</strong></td>
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<tr>
<td><strong>Prerequisites</strong></td>
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<tr>
<td><strong>Duration</strong></td>
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### Learning Goals

In the Master’s thesis, the students show that they are able to work independently and goal-oriented on complex tasks with a scientifically methodical approach. They are able to locate problems in a larger context, to network the technical connections and to present the findings convincingly and argumentatively.
I.1.14.1 Master Thesis

Course: Master Thesis
Lecturer(s): jeweiliger Dozent
Recommended Semester: 3
Frequency: every semester
Course Type: 3
Teaching Methods: thesis
Lessons per Week: 0
ECTS: 28.0
Examination: written documentation (if necessary presentation)
Language: english
Teaching Style: none

Learning Goals
The students are able to ...
- to develop complex tasks independently.
- locate problems in a larger context.
- use scientific methods for problem solving.
- convincingly present results.

Topics
topic-dependent

References
topic-dependent
I.1.15 Master Colloquium

M061 Master Colloquium

<table>
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<tr>
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Learning Goals

The students present their work results convincingly to the examination board. They master the instrument of free speech, argue conclusively and provide evidence.
In a subsequent interdisciplinary oral examination, they defend their work results and prove to be familiar with problems in the discussion.
1.15.1 Colloquium

<table>
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Learning Goals

Topics

References
I.1.16 Business Intelligence

M101 Business Intelligence

Curriculum Master study programme IT Engineering
Identifier M101
Name Business Intelligence
Course(s) M101a Business Intelligence
Authority Prof. Dr. Martin Schultz
Curricula Business Studies (Master)
Computer Science (Master)
E-Commerce (Master)
IT Engineering (Master)
Management and Engineering (Master)
Applications The module can be combined with digital transformation, which puts the importance of data driven decision making in a wider context.
Lessons per Week 6
Credits 5.0
Prerequisites The module “Business Intelligence” builds on the knowledge and competencies the students gained during their bachelor studies. These competencies include statistics and database management.
Duration 1

Learning Goals

Organizations that extensively leverage data driven decisions have a competitive advantage. Examples include Internet firms such as Amazon, Google, or Netflix as well as firms from more traditional industries such as Rolls Royce, Southwest Airlines, or Harrah’s. As the availability of data is constantly increasing across all industries, every organization must learn how to systematically leverage its existing data and how to systematically acquire new data.

Throughout this course you will learn how data can be used for making better business decisions. You will understand the major technological concepts for data storage (e.g., data warehouses and big data), be able to select proper analytical algorithms for a given business problem (e.g., clustering of customers), and be able to implement some of these algorithms by yourself (e.g., linear regression).
I.1.16.1 Business Intelligence

Course  
Business Intelligence

Lecturer(s)  
Martin Schultz

Recommended Semester  
2

Frequency  
annually

Course Type  
2

Teaching Methods  
lecture with tutorial, workshop, assignment

Lessons per Week  
6

ECTS  
5.0

Examination  
written or oral examination (+ bonus points)

Language  
english

Teaching Style  
guest speakers, online content, projector presentation, software presentation, student computer exercises, tutorials

Learning Goals

- You will be able to describe different use cases of data-driven decision making
- You will understand the fundamentals of data warehouses
- You will learn how to apply Online Analytics Processing (OLAP) operators
- You will be able to develop effective dashboards
- You will be able to analyze business problems and select proper predictive analytics algorithms
- You will understand the underlying principles of different algorithms so that you can better assess their strength and weaknesses
- You will understand the basics of big data technology
- You will understand major implications from machine learning and be able to apply some of the basic machine learning algorithms
- You will get an overview of major business intelligence and data analytics tools and gain first experience in some of these tools
- You will learn how to develop a data strategy

Topics
The course aims at providing students with a comprehensive understanding of data-driven decision making in a business context.

Outline

- Introduction to business intelligence
- Traditional understanding of BI (BI architecture, OLAP, data warehouses, dashboards)
- Data analytics (overview, linear regression, time series, decision trees, clustering, …)
- Big data and machine learning (introduction to big data, most important ML algorithms, AI strategy, …)
References

I.1.17 Technical Optics

M115 Technical Optics

Curriculum Master study programme IT Engineering
Identifier M115
Name Technical Optics
Course(s) M115a Technical Optics
Authority Prof. Dr. Ioana Serban
Curricula IT Engineering (Master)
Management and Engineering (Master)
Applications Description of module availability missing
Lessons per Week 4
Credits 5.0
Prerequisites Module requirement missing
Duration 1

Learning Goals
After successful completion of this module, students are able to:

- explain the presented physical concepts and set them in relation to each other
- independently solve problems using the acquired physical concepts and mathematical methods
- critically assess the results and derive conclusions
- design simple lens systems and calculate their optical parameters and aberrations
- explain semiconductor-based light sources and detectors and their role in electronic circuitry
- name different fiber types and their applications in fiber optic communication
I.1.17.1 Technical Optics

Course: Technical Optics
Lecturer(s): Ioana Serban
Recommended Semester: 2
Frequency: annually
Course Type: 2
Teaching Methods: lecture
Lessons per Week: 4
ECTS: 5.0
Examination: different types of examinations
Language: english
Teaching Style: blackboard, handout, interactive development and discussion of models, projector presentation, software presentation, student computer exercises

Learning Goals
After successful completion of this module, students are able to ...

- explain the presented physical concepts and set them in relation to each other
- independently solve problems using the acquired physical concepts and mathematical methods
- critically assess the results and derive conclusions
- design simple lens systems, calculate their optical parameters and correct aberrations
- explain semiconductor-based light sources and detectors and their role in electronic circuitry
- name different fiber types and their applications in fiber optic communications, as well as limitations to the optical data transmission

Topics

- background:
  - ray optics
  - wave optics
    * interference
    * diffraction
    * resolution limits of optical system
  - beam optics
  - Fourier optics, optical filtering, polarization
- optical imaging
– optical aberrations
– the five Seidel aberrations
– methods for aberration correction
– development of optical systems
– specifications of optical systems, dependence of aberrations on optical parameters
– design programs, tolerancing

• optoelectronics
  – semiconductor photon sources and detectors

• fiber optics
  – fiber types
  – attenuation and dispersion
  – fiber optic communications

• optional advanced topics:
  – modulation, switching, and scanning of light: electrically, acoustically, or optically controlled devices
  – wave interactions in nonlinear materials: frequency conversion
  – holographic

References