Description of the degree course

<table>
<thead>
<tr>
<th>Name of the degree course</th>
<th>Shorthand expression of degree course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master Electrical and Electronic Engineering (Communications Engineering) PO08</td>
<td>M-EEE(CE)_PO08</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>Period of study</th>
<th>SWS</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master</td>
<td>4</td>
<td>66</td>
<td>120</td>
</tr>
</tbody>
</table>

**Description**

The study in the master degree course "Electrical and Electronic Engineering" is divided into two profiles, which focus on different directions of this field: The education in the profile "Communications Engineering" qualifies the students for the demanding occupations in management, research and in teaching. After a broad basis by way of a prerequisite respective bachelor degree, the knowledge will be deepened in  
- the higher mathematics and numerical mathematics necessary for the demanding technical subjects as well as magnetic field theory,  
- the technical subjects which form the basis for the demanding activity profile in electrical engineering and information engineering and  
- the technical profile subjects, which allow a demanding occupation in the area of communications.  
Hereby it will be aimed at achieving the following special goals:  
- the ability to familiarise with demanding theoretic topics,  
- the ability to solve demanding tasks which require a multitude of theoretical aids in modelling, synthesis and simulation.

The field of activities for engineers with master degree is sophisticated project planning, development of products (components and systems), research and sales in small companies as well as global acting industry. The master degree is also prerequisite for PhD-programs.
## Study plan

### Master Electrical and Electronic Engineering (Communications Engineering) PO08

**Elektrotechnik und Informationstechnik**

<table>
<thead>
<tr>
<th>Course</th>
<th>Lecturer</th>
<th>V</th>
<th>Ü</th>
<th>P</th>
<th>S</th>
<th>Cr</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.</strong> Communication Networks</td>
<td>Prof. Dr.-Ing. habil. Jung</td>
<td>d</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Mathematics E4</td>
<td>Prof. Dr. Scheven</td>
<td>d</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Numerical Mathematics</td>
<td>Prof. Dr. Scheven</td>
<td>e</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Electromagnetic Field Theory 1</td>
<td>Prof. Dr. sc. techn. Erni</td>
<td>d</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Theory of Statistical Signals</td>
<td>Prof. Dr.-Ing. Czylwik</td>
<td>d</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Elective 1</td>
<td>NN</td>
<td>d/e</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>12</strong></td>
<td><strong>10</strong></td>
<td><strong>0</strong></td>
<td><strong>31</strong></td>
<td></td>
</tr>
</tbody>
</table>

<p>| <strong>2.</strong> Advanced Computer Architecture           | Prof. Dr.-Ing. Hunger                   | e | 2 | 0 | 0 | 4 |
| Coding Theory                                   | Prof. Dr.-Ing. Czylwik                 | e | 2 | 0 | 0 | 4 |
| Electronic Circuits                             | Prof. Dr. rer. nat. Tegude             | d | 2 | 0 | 0 | 4 |
| Electronic Circuits Lab                         | Prof. Dr. rer. nat. Tegude             | d | 0 | 0 | 0 | 1 |
| Mobile Communication Equipment                  | Prof. Dr.-Ing. habil. Jung             | d | 2 | 0 | 0 | 4 |
| Electromagnetic Field Theory 2                  | Prof. dr. sc. techn. Erni              | d | 2 | 0 | 0 | 6 |
| Transmission Technology                         | Prof. Dr.-Ing. Czylwik                 | d | 2 | 0 | 0 | 5 |
| <strong>Total</strong>                                       |                                         | <strong>12</strong> | <strong>8</strong> | <strong>1</strong> | <strong>28</strong> |</p>
<table>
<thead>
<tr>
<th>Course</th>
<th>Professor</th>
<th>Type</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distributed Systems</td>
<td>Prof. Dr.-Ing. Weis</td>
<td>e</td>
<td>3</td>
</tr>
<tr>
<td>Microwave Theory and Techniques</td>
<td>Prof. Dr.-Ing. Czylwik Prof. Dr.-Ing. Solbach</td>
<td>e</td>
<td>2</td>
</tr>
<tr>
<td>Microwave Theory and Techniques Lab</td>
<td>Prof. Dr.-Ing. Czylwik Prof. Dr.-Ing. Solbach</td>
<td>e</td>
<td>0</td>
</tr>
<tr>
<td>Non-technical Catalog M</td>
<td>NN</td>
<td>d/e</td>
<td>0</td>
</tr>
<tr>
<td>Optical Communications Technology OR Image</td>
<td></td>
<td>d/e</td>
<td>2</td>
</tr>
<tr>
<td>Elective 2</td>
<td>NN</td>
<td>d/e</td>
<td>2</td>
</tr>
<tr>
<td>Elective 3</td>
<td>NN</td>
<td>d/e</td>
<td>2</td>
</tr>
<tr>
<td>Master Thesis</td>
<td>NN</td>
<td>d/e</td>
<td>0</td>
</tr>
<tr>
<td>Master Thesis Colloquium</td>
<td>NN</td>
<td>d/e</td>
<td>0</td>
</tr>
</tbody>
</table>

Total: 11 5 1 6 31

Total: 0 0 0 0 30
## Module- und course catalog

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Extended Field Theory</th>
</tr>
</thead>
</table>

| Module Coordinator   | Prof. Dr. sc. techn. Daniel Erni |

### Used in degree course
- Master Elektrotechnik und Informationstechnik (Mikro- und Optoelektronik / Bauelemente und Technologie) PO06
- Master Elektrotechnik und Informationstechnik (Mikro- und Optoelektronik / Schaltungstechnik) PO06
- Master Elektrotechnik und Informationstechnik (Nachrichtentechnik) PO06
- Master NanoEngineering (Nanoelektronik/Nanooptoelektronik) PO06
- Master Electrical and Electronic Engineering (Communications Engineering) PO08

<table>
<thead>
<tr>
<th>Year</th>
<th>Duration</th>
<th>Type of module</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>Pflichtmodul</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Courses/Exams</th>
<th>Semester</th>
<th>SWS</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Electromagnetic Field Theory 1</td>
<td>1</td>
<td>4</td>
<td>180</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Mathematics E4</td>
<td>1</td>
<td>3</td>
<td>150</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Electromagnetic Field Theory 2</td>
<td>2</td>
<td>4</td>
<td>180</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>11</td>
<td>510</td>
<td></td>
<td>17</td>
</tr>
</tbody>
</table>
Module Name
Extended Field Theory

Course/Examination Name
Mathematics E4

Course Coordinator
Prof. Dr. Christoph Scheven

Semester | Cycle | Language
---|---|---
1 | WS | deutsch

<table>
<thead>
<tr>
<th>SWS</th>
<th>Contact hours</th>
<th>Self-study hours</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>45</td>
<td>105</td>
<td>150</td>
<td>5</td>
</tr>
</tbody>
</table>

Teaching form
Lecture with Exercises

Learning objectives
The students are able to compute potential functions of conservative vector fields. They know how to parametrize important surfaces. They are also able to calculate surface- and flow integrals and in so doing apply integral theorems. They know what a boundary value problem is and are capable of solving such problems for simple cases.

Description
The course deals with the following subjects:
- Vector analysis
- Potential functions and line integrals
- Integration in several variables
- Parameterized surfaces
- Surface integrals
- Flow integrals
- Green’s theorem
- Stoke’s theorem
- Gauss’s theorem
- Partial differential equations
- Introduction
- Green’s identities
- Poisson’s integration equations over a circular disk and a sphere
- Fundamentals of Distributions

Kind of examination
Written examination 120 min

Literature
Burg, Haf, Wille: Mathematik für Ingenieure, I-IV, 2002;
Marsden, Tromba: Vectoranalysis, 1996;
Kevorkian: Partial Differential Equations, 2000;
Renardy/Rogers: A first graduate course in Partial Differential Equations, 2004;

Requirements
Mathematik 1 für Ingenieure und Mathematik 2 für Ingenieure.
**Module Name**
Extended Field Theory

**Course/Examination Name**
Electromagnetic Field Theory 1

**Course Coordinator**
Prof. Dr. sc. techn. Daniel Erni

<table>
<thead>
<tr>
<th>Semester</th>
<th>Cycle</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WS</td>
<td>deutsch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWS</th>
<th>Contact hours</th>
<th>Self-study hours</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>60</td>
<td>120</td>
<td>180</td>
<td>6</td>
</tr>
</tbody>
</table>

**Teaching form**
Lecture / Exercises

**Learning objectives**
Based on this course the students are capable:
- to solve an electrostatic boundary problem while using either analytical or numerical methodologies,
- to correctly evaluate the behavior of electrostatic field according to their appearance in technical building blocks and systems,
- to understand the underlying mechanisms of stationary current fields and to provide quantitative measures for their behavior,
- to master vector calculus, vector analysis and to correctly apply these formalisms in the corresponding context of application.

**Description**
The course “Theoretische Elektrotechnik” is aimed towards a profound physical understanding of electromagnetic fields. It represents a key qualification in order to bridge the gap to other realms of electrical engineering, such as e.g. high-voltage engineering, electrical engines, and energy transmission. The course as a whole represents an extension towards classical electrodynamics addressing areas like microwave engineering, solid state electronics and advanced issues in the framework of nanosciences, such as e.g. nanophotonics and nanooptics.

The lecture "Theoretische Elektrotechnik 1" encompasses the following topics:

(1) Electrostatics:

---

- Electric field and electric flux density
- The fundamental equations (Gauss law, conservative fields)
- The electrostatic potential
- The general theory of capacitance
- Electrostatic field in material media
- Boundary conditions
- Energy and forces
- The electrostatic boundary value problem
- Analytical, graphical, semi-analytical, direct und iterative numerical solution methods

(2) Stationary electric fields in conducting media:

---

- Current and current density
- The fundamental equations (continuity equation, Ohm’s law)
- Boundary conditions
- Power density
- Calculation of the resistance
- The stationary boundary value problem
- Duality to electrostatics

The course also covers the fundamentals of vector calculus, vector analysis, coordinate systems, and some elements of tensor calculus.

**Kind of examination**

written examination (120 min).

**Literature**


**Requirements**

- Vektoranalysis,
- Differenzialgleichungen,
- Stoffumfang der Veranstaltung "Grundlagen der Elektrotechnik 1,2,3".
## Module Name
Extended Field Theory

## Course/Examination Name
Electromagnetic Field Theory 2

## Course Coordinator
Prof. Dr. sc. techn. Daniel Erni

<table>
<thead>
<tr>
<th>Semester</th>
<th>Cycle</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>SS</td>
<td>deutsch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWS</th>
<th>Contact hours</th>
<th>Self-study hours</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>60</td>
<td>120</td>
<td>180</td>
<td>6</td>
</tr>
</tbody>
</table>

## Teaching form
Lecture / Exercises

## Learning objectives
Based on this course the students are capable,
- to express electromagnetic fields in both their differential and their integral representation,
- to model magnetostatic systems based on magnetic currents and magnetic charges.
- to design electromagnetic shielding applications
- to understand time harmonic fields and to apply this concept in the corresponding technical context,
- to provide mathematical formulations for radiation fields,
- to correctly evaluate spatio-temporal behavior of radiation fields within building blocks and systems.
- to validate different waveguide structures according to the intended application.

## Description
The course “Theoretische Elektrotechnik” is aimed towards a profound physical understanding of electromagnetic fields. It represents a key qualification in order to bridge the gap to other realms of electrical engineering, such as e.g. high-voltage engineering, electrical engines, and energy transmission. The course as a whole represents an extension towards classical electrodynamics addressing areas like microwave engineering, communication systems, solid state electronics and advanced issues in the framework of nanosciences, such as e.g. nanophotonics and nanooptics.

The lecture "Theoretische Elektrotechnik 2” addresses the following topics:

1. Magnetostatics:
   - Magnetic field and magnetic flux density
   - The fundamental equations (Biot-Savart law, Ampere’s law)
   - Magnetic potentials
   - Magnetic fields in material media
   - Boundary conditions
   - Magnetic flux

2. Slowly-varying fields:
   - Electromagnetic induction (Faraday’s law)
   - The inductance
   - Energy and forces
   - The displacement current
(3) Electromagnetic field diffusion:
- Timeharmonic fields
- Electro-quasistatics and Magneto-quasistatics
- Diffusion equation
- Skin effect, shielding, current displacement, and eddy currents.

(4) Electrodynamical fields:
- Electromagnetic radiation
- Energy and momentum conservation (Poynting theorem, electromagnetic stress tensor)
- Radiation sources
- Retarded potentials
- Plane waves
- Waveguide modes and radiation modes
- Polarization and dispersion

Kind of examination
Written exam of 2 hours duration.

Literature

Requirements
- Vektoranalysis,
- Differenzialgleichungen,
- Stoffumfang der Veranstaltung "Grundlagen der Elektrotechnik 1,2,3"
- Stoffumfang der Veranstaltung "Theoretische Elektrotechnik 1"
## Module Name
Communication Networks and Mobile Communication Networks

## Module Coordinator
Prof. Dr.-Ing. habil. Peter Jung

## Used in degree course
- Master Electrical and Electronic Engineering (Communications Engineering) PO08

<table>
<thead>
<tr>
<th>Year</th>
<th>Duration</th>
<th>Type of module</th>
</tr>
</thead>
<tbody>
<tr>
<td>1+2</td>
<td>3</td>
<td>Pflichtmodul</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Courses/Exams</th>
<th>Semester</th>
<th>SWS</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Communication Networks</td>
<td>1</td>
<td>4</td>
<td>150</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Mobile Communication Equipment</td>
<td>2</td>
<td>3</td>
<td>120</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Optical Communications Technology OR Image Signal Technology</td>
<td>3</td>
<td>3</td>
<td>120</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>10</td>
<td>390</td>
<td></td>
<td>13</td>
</tr>
</tbody>
</table>
Module Name
Communication Networks and Mobile Communication Networks

Course/Examination Name
Communication Networks

Course Coordinator
Prof. Dr.-Ing. habil. Peter Jung

<table>
<thead>
<tr>
<th>Semester</th>
<th>Cycle</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WS</td>
<td>deutsch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWS</th>
<th>Contact hours</th>
<th>Self-study hours</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>60</td>
<td>90</td>
<td>150</td>
<td>5</td>
</tr>
</tbody>
</table>

Teaching form
Lecture and exercises (in German)

Learning objectives
1) Understand hierarchical structure of communication networks, using the OSI model.
2) Understand the main functionality of the three lower layers of the OSI model.
3) Understand the basics of queuing theory.

Description
In the lecture "Kommunikationsnetze" an overview over the basics of digital communication is given. For this the following themes are treated:
- Basic terms
- Hierarchical structures of network functions (OSI-layered model)
- Methods for point-to-point communication
- Multiple access protocols
- Methods for reliable data transmission
- Routing and flow control
- Queuing theory

The contents are self-absorbed in exercises and seminars.

Kind of examination
written exam (90 min.)

Literature
Module Name
Communication Networks and Mobile Communication Networks

Course/Examination Name
Mobile Communication Equipment

Course Coordinator
Prof. Dr.-Ing. habil. Peter Jung

<table>
<thead>
<tr>
<th>Semester</th>
<th>Cycle</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>SS</td>
<td>deutsch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWS</th>
<th>Contact hours</th>
<th>Self-study hours</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>45</td>
<td>75</td>
<td>120</td>
<td>4</td>
</tr>
</tbody>
</table>

Teaching form
Lecture and exercises (in German)

Learning objectives
1. Understanding the basic architecture of mobile terminals, e.g. cellular phones.
2. Understanding the basics of detection and estimation.
3. Understanding the realization aspects of detectors and estimators for mobile terminals.

Description
The lecture consists of thirteen separate course entities, namely:
1. Architecture of mobile communication terminals and their applications in the automotive sector
2. Binary Bayes detection of isolated messages
3. Binary detection in additive noise
4. Maximum likelihood (ML) sequence detection, MLSD
5. Maximum a posteriori probability (MAP) symbol detection
6. Illustrative examples for MAP symbol detection
7. Optimal estimators based on the MAP and on the ML criteria
8. Linear estimation
9. Realization aspects of digital signal processing in mobile terminals
10. Wireless connectivity in the automotive environment (Bluetooth, W-LAN, UWB, Keyless Entry)

Kind of examination
Written examination, 90 minutes

Literature
**Module Name**  
Communication Networks and Mobile Communication Networks

**Catalog Name**  
Optical Communications Technology OR Image Signal Technology

<table>
<thead>
<tr>
<th>Semester</th>
<th>Cycle</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>WS</td>
<td>deutsch/englisch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWS</th>
<th>Contact hours</th>
<th>Self-study hours</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>45</td>
<td>75</td>
<td>120</td>
<td>4</td>
</tr>
</tbody>
</table>

**Veranstaltungen / Module im Katalog**
- Bildsignaltechnik
- Optical Communications Technology

**Learning objectives**
With a targeted choice of the elective subjects, the students should follow their affinities.

**Description**
The Students choose between these courses according to their preferences.

**Kind of examination**
The type and duration of the examination depends on the chosen course.
<table>
<thead>
<tr>
<th>Nr.</th>
<th>Courses/Exams</th>
<th>Semester</th>
<th>SWS</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Theory of Statistical Signals</td>
<td>1</td>
<td>4</td>
<td>150</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Transmission Technology</td>
<td>2</td>
<td>4</td>
<td>150</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Coding Theory</td>
<td>2</td>
<td>3</td>
<td>120</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>11</td>
<td>420</td>
<td>14</td>
</tr>
</tbody>
</table>
**Module Name**
Theoretical Communications Engineering

**Course/Examination Name**
Theory of Statistical Signals

**Course Coordinator**
Prof. Dr.-Ing. Andreas Czylwik

<table>
<thead>
<tr>
<th>Semester</th>
<th>Cycle</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WS</td>
<td>deutsch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWS</th>
<th>Contact hours</th>
<th>Self-study hours</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>60</td>
<td>90</td>
<td>150</td>
<td>5</td>
</tr>
</tbody>
</table>

**Teaching form**
Lecture and exercise

**Learning objectives**
A lot of processes (from physics, economics, biology, technology …) cannot be described only with deterministic relationships, but need statistical methods. Students who have completed this course should be able to apply the concepts from stochastic variables and stochastic processes in practical problems.

**Description**
After a sound introduction in the notion of probability, stochastic variables will be discussed in detail. To that belong the different description possibilities through probability density function, probability distribution function and characteristic function. Beyond that, the properties of functions from stochastic variables will be handled. Stochastic processes which are extended from stochastic variables in time dimension will be emphasized on. Second-order moments such as the autocorrelation function, the cross correlation function as well as the corresponding power spectral density will be particularly discussed. Special stochastic processes of great practical importance such as the Gauss’s and Poisson’s processes will be handled. In conclusion, applications like optimal filters and modulation will be discussed. The contents will be deepened in exercises.

**Kind of examination**
Written examination (90 min)

**Literature**
Module Name
Theoretical Communications Engineering

Course/Examination Name
Coding Theory

Course Coordinator
Prof. Dr.-Ing. Andreas Czylwik

<table>
<thead>
<tr>
<th>Semester</th>
<th>Cycle</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>SS</td>
<td>englisch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWS</th>
<th>Contact hours</th>
<th>Self-study hours</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>45</td>
<td>75</td>
<td>120</td>
<td>4</td>
</tr>
</tbody>
</table>

Teaching form
Lecture and exercise

Learning objectives
The students who have completed this course should be able to develop codes from some predefined properties. The needed procedures will be taught both in the lecture and during the exercises session based on some examples. Moreover, they should know how to develop decoding techniques and use them and also be able to judge their effectiveness and efficiency.

Description
The subject coding theory amply introduces the students to the various coding techniques. After an introduction to information theory basics, primary procedures of source coding will be handled. The emphasis of the lecture lies on the procedures of channel coding. Here, block codes, in particular cyclic codes and Reed-Solomon-Codes including their performance, coding techniques as well as decoding techniques will be discussed. In conclusion, convolutional codes, their efficiency and their description will be discussed too. The Viterbi algorithm will be used as decoding method.

Kind of examination
Written examination (90 min)

Literature
H. Schneider-Obermann: Kanalcodierung, Vieweg-Verlag 1998;
B. Friederichs: Kanalcodierung, Springer-Verlag 1994;
M. Bossert: Kanalcodierung, Teubner-Verlag 1992

Requirements
keine
### Module Name
Theoretical Communications Engineering

### Course/Examination Name
Transmission Technology

### Course Coordinator
Prof. Dr.-Ing. Andreas Czylwik

<table>
<thead>
<tr>
<th>Semester</th>
<th>Cycle</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>SS</td>
<td>deutsch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWS</th>
<th>Contact hours</th>
<th>Self-study hours</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>60</td>
<td>90</td>
<td>150</td>
<td>5</td>
</tr>
</tbody>
</table>

### Teaching form
Lecture and exercise

### Learning objectives
The students have a solid basic understanding in the domain of digital and analog transmission processes. They are able to classify various processes, to analyze them and to develop new ones.

### Description
The lecture „Transmission technology“ initiates the students in the digital and analog transmission processes. The discussed transmission processes will be analyzed with the help of statistic methods. In the domain of analog transmission processes, amplitude- and angle modulation, equivalent baseband systems, band-pass noise as well as preemphasis- and Deemphasis filters will be handled. The focal points of the lecture are the digital transmission processes such as pulse-amplitude modulation (PAM), quadrature amplitude modulation (QAM), orthogonal frequency-division multiplexing (OFDM). It will be particularly emphasized on the special problem of channels with intersymbol interference. Optimal and suboptimale receiving methods will be discussed as well. The content of the lecture will be deepened in exercises.

### Kind of examination
Written examination (90 min)

### Literature
S. Benedetto, E. Biglieri, and V. Castellani: Digital transmission theory, Prentice-Hall, 1987
<table>
<thead>
<tr>
<th>Module Name</th>
<th>Electronic Circuits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module Coordinator</strong></td>
<td>Prof. Dr. rer. nat. Franz-Josef Tegude</td>
</tr>
<tr>
<td><strong>Used in degree course</strong></td>
<td></td>
</tr>
<tr>
<td>• Master Electrical and Electronic Engineering (Communications Engineering) PO08</td>
<td></td>
</tr>
<tr>
<td>• Master Electrical and Electronic Engineering (Power and Automation) PO08</td>
<td></td>
</tr>
<tr>
<td>• Master Communications Engineering PO15</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Duration</th>
<th>Type of module</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Pflichtmodul</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Courses/Exams</th>
<th>Semester</th>
<th>SWS</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Electronic Circuits</td>
<td>2</td>
<td>3</td>
<td>120</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Electronic Circuits Lab</td>
<td>2</td>
<td>1</td>
<td>30</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>150</td>
<td>5</td>
</tr>
</tbody>
</table>
Teaching form
The "Electronic Circuits" consists of a lecture (2 hrs) and an exercise (1 hr). Fundamental AC-characteristics of various electronic circuits based on FET- and bipolar transistors are treated.

Learning objectives
The students are able to understand and analyse the AC-characteristics of complex analog and digital circuits.

Description
Based on the small-signal analysis of electronic devices like diodes, field-effect transistors (FET) and bipolar transistors fundamental methods to calculate and design complex electronic circuits are introduced and applied. Basic circuits and their characteristics are analysed and discussed in detail. Both, analog and digital circuits are treated.

Kind of examination
Written examination, 120 minutes. The language of the examination is the same as the language of the lecture.

Literature
- F.J.Tegude, "Festkörperelektronik", Skript zur Vorlesung, Universität Duisburg - Essen
- U.Tietze, Ch. - Schenk, "Halbleiterschaltungsstechnik", Springer-Verlag, Berlin
- J. Borgmeyer, "Grundlagen der Digitaltechnik", Hanser Lehrbuch, Carl Hanser Verlag München, ISBN 3-
Module Name
Electronic Circuits

Course/Examination Name
Electronic Circuits Lab

Course Coordinator
Prof. Dr. rer. nat. Franz-Josef Tegude

<table>
<thead>
<tr>
<th>Semester</th>
<th>Cycle</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>SS</td>
<td>deutsch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWS</th>
<th>Contact hours</th>
<th>Self-study hours</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15</td>
<td>15</td>
<td>30</td>
<td>1</td>
</tr>
</tbody>
</table>

Teaching form
Self-dependent preparation, measurements of electronic devices and circuits under supervision including final analysis of the measurement results.

Learning objectives
The students are able to measure electronic devices and circuits, to interpret the measurement results and to optimize amplifier circuits.

Description
The lab is a supplement of the lecture "electronic circuits" to intensify the understanding of the analysis of electronic circuits.
It consists of three practical exercises:
- the investigation of simple digital circuits
- the switching behaviour of bipolar transistors and
- the analysis of amplifier circuits using a circuit simulator

Kind of examination
Oral admission test at the beginning of the lab.

Literature
- Skript der Veranstaltung "Elektronische Bauelemente"
- Skript der Veranstaltung "Elektronische Schaltungen"
- Versuchbeschreibungen
<table>
<thead>
<tr>
<th>Module Name</th>
<th>Microwave Theory and Techniques</th>
</tr>
</thead>
</table>
| Module Coordinator | Prof. Dr.-Ing. Andreas Czyglfwik  
                     | Prof. Dr.-Ing. Klaus Solbach |
| Used in degree course |  
                         | Master Electrical and Electronic Engineering (Communications Engineering) PO08  
                         | Master Elektrotechnik und Informationstechnik (Nachrichtentechnik) PO12  
                         | Master Communications Engineering PO15 |
| Year | Duration | Type of module |
| 2 | 1 | Pflichtmodul |
| Nr. | Courses/Exams | Semester | SWS | Workload in h | ECTS-Credits |
| 1 | Microwave Theory and Techniques | 3 | 3 | 120 | 4 |
| 2 | Microwave Theory and Techniques Lab | 3 | 1 | 30 | 1 |
| Total | | 4 | | 150 | 5 |
Module Name
Microwave Theory and Techniques

Course/Examination Name
Microwave Theory and Techniques

Course Coordinator
Prof. Dr.-Ing. Andreas Czylik
Prof. Dr.-Ing. Klaus Solbach

Semester | Cycle | Language
--- | --- | ---
3 | WS | englisch

SWS | Contact hours | Self-study hours | Workload in h | ECTS-Credits
--- | --- | --- | --- | ---
3 | 45 | 75 | 120 | 4

Teaching form
Lecture for the introduction of fundamental theory, complemented by few examples. Exercises for the application of theory to practical problems which are calculated in detail.

Learning objectives
Students can calculate electromagnetic wave propagation in free space and in transmission lines. They are able to describe wave propagation properties of microwave networks and consider these under system aspects.

Description
The lecture series on MTT covers advanced theories and concepts needed for the analysis and design of microwave circuits. We start with Maxwell’s equations to derive descriptions of plane waves and propagation effects at discontinuities. Next we repeat and extend transmission line theory taught at undergraduate level (MRFT). Extending basic theory, we then derive transmission line TEM-modes and metal waveguide TE- and TM-modes as well as resonator modes. Characteristics of printed circuit microstrip line and coplanar waveguide are also presented. This leads to the characterization of microwave networks using scattering parameters and the analysis of several classes of n-port circuits.

Kind of examination
Written test with a length of 120 minutes. The language of the examination is the same as the language of the lecture.

Literature
- David M. Pozar, Microwave and RF wireless systems, John Wiley and Sons, 2001, chapters 3,4
- David M. Pozar, Microwave Engineering, 2nd edition, John Wiley and Sons, 1998, chapters 1,2,3,4
- Werner Bächtold, Mikrowellentechnik, Vieweg, 1999
- Werner Bächtold, Mikrowellenelektronik, Vieweg, 2002

Requirements
Mathematik E4, Hochfrequenztechnik (Bachelor-Niveau)
Module Name
Microwave Theory and Techniques

Course/Examination Name
Microwave Theory and Techniques Lab

Course Coordinator
Prof. Dr.-Ing. Andreas Czylwik
Prof. Dr.-Ing. Klaus Solbach

Semester | Cycle | Language
--- | --- | ---
3 | WS | englisch

<table>
<thead>
<tr>
<th>SWS</th>
<th>Contact hours</th>
<th>Self-study hours</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15</td>
<td>15</td>
<td>30</td>
<td>1</td>
</tr>
</tbody>
</table>

Teaching form
The lab experiments are performed by the students in groups of three with help from a tutor. Students prepare and evaluate the lab experiments on their own.

Learning objectives
The students are able to verify experimentally and understand better the theoretical concepts from the lecture about simple circuits and networks for microwave technology and can apply this to practical problems of engineering.

Description
The MTT lecture is complemented with a series of lab experiments which comply with the topics presented in the lecture but also present some additional topics concerning active microwave circuits:
- Measurement of scattering parameters of passive and active circuits
- Measurement of impedance in waveguide circuits
- Characterization of amplifiers (Gain, Noise Figure, Distortion)
- Spectral characterization of mixer circuits
- Measurement of antenna parameters using the far-field anechoic chamber
The experiments are accompanied by a script that collects and repeats theoretical fundamentals and presents questions and problems to be solved before the experiments (homework).
The lab comprises a colloquium at the beginning to check the good preparation of students and grant the testation, the accomplishment of the experiments by individual student in groups and a final report and discussion of results. Detailed evaluations of results have to be prepared for the next experiment and successful performance is the basis for earning the credit points of the module.

Kind of examination
Before the start of the lab experiments, students have to prove they are well prepared. Students will be denied if failing to do so. The credit points for a successful completion of the lab experiments are only granted for a minimum of passed lab experiments.

Literature
Ausführliche Versuchsbeschreibungen erhältlich unter https://www.uni-due.de/hft/mtt.php
## Module Name
Cross Section Module CE

### Module Coordinator
Prof. Dr.-Ing. Holger Hirsch

### Used in degree course
- Master Electrical and Electronic Engineering (Communications Engineering) PO08

<table>
<thead>
<tr>
<th>Year</th>
<th>Duration</th>
<th>Type of module</th>
</tr>
</thead>
<tbody>
<tr>
<td>1+2</td>
<td>3</td>
<td>Pflichtmodul</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Courses/Exams</th>
<th>Semester</th>
<th>SWS</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Numerical Mathematics</td>
<td>1</td>
<td>4</td>
<td>180</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Advanced Computer Architecture</td>
<td>2</td>
<td>3</td>
<td>120</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Distributed Systems</td>
<td>3</td>
<td>4</td>
<td>180</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>11</strong></td>
<td></td>
<td><strong>480</strong></td>
<td><strong>16</strong></td>
</tr>
</tbody>
</table>
Module Name
Cross Section Module CE

**Course/Examination Name**
Numerical Mathematics

**Course Coordinator**
Prof. Dr. Christoph Scheven

<table>
<thead>
<tr>
<th>Semester</th>
<th>Cycle</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WS</td>
<td>englisch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWS</th>
<th>Contact hours</th>
<th>Self-study hours</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>60</td>
<td>120</td>
<td>180</td>
<td>6</td>
</tr>
</tbody>
</table>

**Teaching form**
Lecture / Exercise

**Learning objectives**
The students should learn, to solve typical problems in engineering-mathematics by numerical methods, among others: Linear and nonlinear systems, eigenvalues, interpolation, differential equations and integration. They should learn to implement general methods into a practical computation and to evaluate them with respect to accuracy and efficiency.

**Description**
The course deals with the following subjects:
1 Error Analysis
   Representation of numbers, Floating-point-numbers, Rounding errors, Error Propagation, Error propagation in arithmetic operations, Condition numbers
2 Nonlinear equations
3 Systems of Linear Equations
4 Finding Eigenvalues
   The Power method, Localizing eigenvalues, The QR-method, Hessenberg matrices
5 Ordinary Differential Equations
   Basic analytic methods, Separation of variables, Linear differential equations, One-step-methods, Euler’s Method, Midpoint Euler, Two-stage-models, Runge-Kutta-methods
6 Polynomial Interpolation
   Lagrange form of Interpolation Polynomial, Interpolation Error, Divided Differences, Spline Interpolation
7 Numerical Integration
   Gaussian Quadrature

**Kind of examination**
written exam 120 min.
<table>
<thead>
<tr>
<th>Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 Philipps, C. and Cornelius, B. Computational Numerical Methods, Ellis Horwood.</td>
</tr>
<tr>
<td>7 Stoer, J. and Burlisch, R. Introduction to numerical Analysis, 2005.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematik 1 für Ingenieure und Mathematik 2 für Ingenieure</td>
</tr>
</tbody>
</table>
Module Name
Cross Section Module CE

Course/Examination Name
Advanced Computer Architecture

Course Coordinator
Prof. Dr.-Ing. Axel Hunger

<table>
<thead>
<tr>
<th>Semester</th>
<th>Cycle</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>SS</td>
<td>englisch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWS</th>
<th>Contact hours</th>
<th>Self-study hours</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>45</td>
<td>75</td>
<td>120</td>
<td>4</td>
</tr>
</tbody>
</table>

Teaching form
Lectures and Tutorials with usage of MS-Power Point

Learning objectives
The students are able to describe modern concepts of computer architectures and to explain their advantages against conventional von-Neumann computer architectures. They are further able to evaluate computer architectures with regard to efficiency related to different applications.

Description
Students of this course learn about the modern computer architecture concepts that allow the construction of high performing computer systems and networks. They understand the concepts which enable modern computers to overcome the limitations of the traditional von-Neumann architecture when designing computers, such as pipelining, superscalar and vector architectures. Based on these concepts, they learn to distinguish distributed which further increases of performance can be reached by distributed computer architectures including arrays of computers as well as different types of loosely and tightly coupled CPUs. In this context permutation networks are introduced as special aspects of highly specialized and performing computer arrays. By way of topics like cache coherency in parallel systems, students learn to estimate which negative aspects of parallel computer architectures lead to limitations of theoretical possible performance. Finally, modern supercomputers and their properties are presented, and a survey of current developments in the area of "Grid Computing" and "Cloud Computing" are given and discussed.

Kind of examination
Written examination 90 min.

Literature

Requirements
Grundlagen der Technischen Informatik, Fundamentals of Computer Engineering Betriebssysteme und Rechnernetze, Operating Systems & Computer Networks
Module Name
Cross Section Module CE

Course/Examination Name
Distributed Systems

Course Coordinator
Prof. Dr.-Ing. Torben Weis

Semester | Cycle | Language
---|---|---
3 | WS | englisch

SWS | Contact hours | Self-study hours | Workload in h | ECTS-Credits
---|---|---|---|---
4 | 60 | 120 | 180 | 6

Teaching form
Lecture (3 SWS), Exercise (1 SWS)

Learning objectives
The students know the principles, protocols, algorithms and architecture of distributed systems are able to apply these to real world problems.

Description
The lecture presents important concepts and protocols for distributed systems.

The lecture starts with principles of distributed communication:
- Data serialization (ASN.1, CORBA XDR, SOAP)
- Remote procedure calls
- Distributed objects

The second part of the lecture presents important and often used distributed algorithms:
- Physical clocks
- Logical clocks
- Transactions
- Synchronisation
- Replication and consistency
- Global state

Kind of examination
Written exam (90 min.)

Literature
## Module Name

**Electives Module**

## Module Coordinator

NN

## Used in degree course

- Master Computer Engineering PO04
- Master Computer Science and Communications Engineering PO04
- Master Control and Information Systems PO04
- Master Electrical and Electronic Engineering (Communications Engineering) PO04
- Master Electrical and Electronic Engineering (Power and Automation) PO04
- Master Mechanical Engineering (Water Resources and Environmental Engineering) PO04
- Master Mechanical Engineering (Production and Logistics) PO04
- Master Mechanical Engineering (Mechatronics) PO04
- Master Mechanical Engineering (General Mechanical Engineering) PO04
- Master Management and Technology of Water and Waste Water PO08
- Master Automation and Control Engineering PO08
- Master Electrical and Electronic Engineering (Communications Engineering) PO08
- Master Electrical and Electronic Engineering (Power and Automation) PO08
- Master Computer Engineering (Reliable Systems) PO08
- Master Computer Engineering (Interactive Systems and Visualization) PO08
- Master Computer Science and Communications Engineering PO08
- Master Mechanical Engineering (Energy and Environmental Engineering) PO08
- Master Metallurgy and Metal Forming PO08
- Master Mechanical Engineering (General Mechanical Engineering) PO08
- Master Mechanical Engineering (Mechatronics) PO08
- Master Mechanical Engineering (Production and Logistics) PO08

## Year | Duration | Type of module
--- | --- | ---
1+2 | 3 | Wahlpflichtmodul

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Courses/Exams</th>
<th>Semester</th>
<th>SWS</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Elective 1</td>
<td>1</td>
<td>3</td>
<td>120</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Elective 2</td>
<td>3</td>
<td>3</td>
<td>120</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Elective 3</td>
<td>3</td>
<td>3</td>
<td>120</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>9</strong></td>
<td><strong>360</strong></td>
<td></td>
<td><strong>12</strong></td>
</tr>
<tr>
<td>Semester</td>
<td>Cycle</td>
<td>Language</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>-------</td>
<td>------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>deutsch/englisch</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWS</th>
<th>Contact hours</th>
<th>Self-study hours</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>45</td>
<td>75</td>
<td>120</td>
<td>4</td>
</tr>
</tbody>
</table>

**Teaching form**

**Learning objectives**

With a targeted choice of the elective subjects, the students should follow their affinities and qualify themselves for a job resp. for an academic career.

**Description**

The electives module should give the students the opportunity to expand the focus of their study program and of their specialization. By so doing, the deepness of the disciplinary education becomes more important. This can be on one hand very precious for a clearly defined professional use but on the other hand a door-opening to a scientific research (PhD) consecutive to the master degree. Alternatively, other subjects, which are relevant of other study fields of the Faculty of Engineering or which belong to other specializations, could also be chosen. In this way, interdisciplinary abilities, which are considerably important in the professional world in the sense of double qualifications, could be acquired.

**Kind of examination**

According to the examination regulation the type and duration of the examination will be defined from the lecturer before the semester starts.

**Literature**
Module Name
Electives Module

Course/Examination Name
Elective 2

Course Coordinator
NN

<table>
<thead>
<tr>
<th>Semester</th>
<th>Cycle</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td></td>
<td>deutsch/englisch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWS</th>
<th>Contact hours</th>
<th>Self-study hours</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>45</td>
<td>75</td>
<td>120</td>
<td>4</td>
</tr>
</tbody>
</table>

Teaching form

Learning objectives
With a targeted choice of the elective subjects, the students should follow their affinities and qualify themselves for a job resp. for an academic career.

Description
The electives module should give the students the opportunity to expand the focus of their study program and of their specialization. By so doing, the deepness of the disciplinary education becomes more important. This can be on one hand very precious for a clearly defined professional use but on the other hand a door-opening to a scientific research (PhD) consecutive to the master degree. Alternatively, other subjects, which are relevant of other study fields of the Faculty of Engineering or which belong to other specializations, could also be chosen. In this way, interdisciplinary abilities, which are considerably important in the professional world in the sense of double qualifications, could be acquired.

Kind of examination
According to the examination regulation the type and duration of the examination will be defined from the lecturer before the semester starts.

Literature
### Module Name

Electives Module

### Course/Examination Name

Elective 3

### Course Coordinator

NN

### Semester Cycle Language

<table>
<thead>
<tr>
<th>Semester</th>
<th>Cycle</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td></td>
<td>deutsch/englisch</td>
</tr>
</tbody>
</table>

### SWS Contact hours Self-study hours Workload in h ECTS-Credits

| 3 | 45 | 75 | 120 | 4 |

### Teaching form

### Learning objectives

With a targeted choice of the elective subjects, the students should follow their affinities and qualify themselves for a job resp. for an academic career.

### Description

The electives module should give the students the opportunity to expand the focus of their study program and of their specialization. By so doing, the deepness of the disciplinary education becomes more important. This can be on one hand very precious for a clearly defined professional use but on the other hand a door-opening to a scientific research (PhD) consecutive to the master degree. Alternatively, other subjects, which are relevant of other study fields of the Faculty of Engineering or which belong to other specializations, could also be chosen. In this way, interdisciplinary abilities, which are considerably important in the professional world in the sense of double qualifications, could be acquired.

### Kind of examination

According to the examination regulation the type and duration of the examination will be defined from the lecturer before the semester starts.

### Literature
Module Name
Non-technical Subjects M

Module Coordinator
NN

Used in degree course
- Master Computational Mechanics PO07
- Master Management and Technology of Water and Waste Water PO08
- Master Automation and Control Engineering PO08
- Master Electrical and Electronic Engineering (Communications Engineering) PO08
- Master Electrical and Electronic Engineering (Power and Automation) PO08
- Master Computer Science and Communications Engineering PO08
- Master Mechanical Engineering (Energy and Environmental Engineering) PO08
- Master Metallurgy and Metal Forming PO08
- Master Mechanical Engineering (General Mechanical Engineering) PO08
- Master Mechanical Engineering (Mechatronics) PO08
- Master Mechanical Engineering (Production and Logistics) PO08
- Master Automation and Control Engineering PO15
- Master Communications Engineering PO15
- Master Power Engineering PO15
- Master Computer Engineering (Interactive Systems and Visualization) PO15
- Master Computer Engineering (Intelligent Networked Systems) PO15
- Master Embedded Systems Engineering PO15
- Master Management and Technology of Water and Waste Water PO15
- Master Metallurgy and Metal Forming PO15
- Master Mechanical Engineering (General Mechanical Engineering) PO15
- Master Mechanical Engineering (Mechatronics) PO15
- Master Mechanical Engineering (Production and Logistics) PO15
- Master Mechanical Engineering (Energy and Environmental Engineering) PO15
- Master Computational Mechanics PO15
- Master Mechanical Engineering (Ship and Offshore Technology) PO15

<table>
<thead>
<tr>
<th>Year</th>
<th>Duration</th>
<th>Type of module</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td>Wahlmodul</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Courses/Exams</th>
<th>Semester</th>
<th>SWS</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Non-technical Catalog M</td>
<td>3</td>
<td>0</td>
<td>240</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td>6</td>
<td><strong>240</strong></td>
<td><strong>8</strong></td>
</tr>
</tbody>
</table>
Module Name
Non-technical Subjects M

Course/Examination Name
Non-technical Catalog M

Course Coordinator
NN

<table>
<thead>
<tr>
<th>Semester</th>
<th>Cycle</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>WS+SS</td>
<td>deutsch/englisch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWS</th>
<th>Contact hours</th>
<th>Self-study hours</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>90</td>
<td>150</td>
<td>240</td>
<td>8</td>
</tr>
</tbody>
</table>

Teaching form
The type of instruction depends on the chosen course.

Learning objectives
The module aims at deepening the general knowledge of the students and resp. at improving their language skills as well as strengthening their professional qualifications through the learning of teamwork and expose techniques.

Description
This module offers the students the opportunity to, besides the pure technical courses they take, attend some so called “non-technical subjects” and latter provide an attest for them. These courses can be chosen from the overall offers of the Duisburg-Essen university, whereby the “Institut für Optionale Studien“(IOS) proposes a catalog containing courses which fall under the named supplementary area.

Kind of examination
The type and duration of the examination will be defined from the lecturer before the semester starts.

Literature
Spezifisch für das gewählte Thema
<table>
<thead>
<tr>
<th>Module Name</th>
<th>Master-Thesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Coordinator</td>
<td>NN</td>
</tr>
<tr>
<td>Used in degree course</td>
<td></td>
</tr>
<tr>
<td>• Master Computational Mechanics PO07</td>
<td></td>
</tr>
<tr>
<td>• Master Management and Technology of Water and Waste Water PO08</td>
<td></td>
</tr>
<tr>
<td>• Master Automation and Control Engineering PO08</td>
<td></td>
</tr>
<tr>
<td>• Master Electrical and Electronic Engineering (Communications Engineering) PO08</td>
<td></td>
</tr>
<tr>
<td>• Master Electrical and Electronic Engineering (Power and Automation) PO08</td>
<td></td>
</tr>
<tr>
<td>• Master Computer Engineering (Reliable Systems) PO08</td>
<td></td>
</tr>
<tr>
<td>• Master Computer Engineering (Interactive Systems and Visualization) PO08</td>
<td></td>
</tr>
<tr>
<td>• Master Computer Science and Communications Engineering PO08</td>
<td></td>
</tr>
<tr>
<td>• Master Mechanical Engineering (Energy and Environmental Engineering) PO08</td>
<td></td>
</tr>
<tr>
<td>• Master Metallurgy and Metal Forming PO08</td>
<td></td>
</tr>
<tr>
<td>• Master Mechanical Engineering (General Mechanical Engineering) PO08</td>
<td></td>
</tr>
<tr>
<td>• Master Mechanical Engineering (Mechatronics) PO08</td>
<td></td>
</tr>
<tr>
<td>• Master Mechanical Engineering (Production and Logistics) PO08</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Duration</th>
<th>Type of module</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td>Wahlpflichtmodul</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Courses/Exams</th>
<th>Semester</th>
<th>SWS</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Master Thesis</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>27</td>
</tr>
<tr>
<td>2</td>
<td>Master Thesis Colloquium</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td>30</td>
</tr>
</tbody>
</table>
Module Name
Master-Thesis

Course/Examination Name
Master Thesis

Course Coordinator
NN

<table>
<thead>
<tr>
<th>Semester</th>
<th>Cycle</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td></td>
<td>deutsch/englisch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWS</th>
<th>Contact hours</th>
<th>Self-study hours</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>27</td>
</tr>
</tbody>
</table>

Teaching form

Master Thesis
6 month
including a colloquium

Learning objectives

The master thesis is used to show that a student is capable of processing a problem from the corresponding field of engineering sciences autonomously and with scientific methods and presenting it comprehensibly, within a given period of time.

Description

The master thesis is an examination paper which concludes the scientific education in every master degree course within the academic program ISE. Within the colloquium the students will present intermediate and final results of their master thesis and will also participate in discussions of other thesis projects.

Kind of examination

A master thesis can be topically assigned without restrictions somewhere inside the faculty of engineering sciences. The processing time for a master thesis amounts to six months. The master thesis has to be drafted in German or English language and three hardcopies have to be handed in to the examination committee in time. The hardcopies have to be in DIN A4 format and they have to be bound. The master thesis shall normally consist out of 40 to 60 pages.

Literature
<table>
<thead>
<tr>
<th>Module Name</th>
<th>Master-Thesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course/Examination Name</td>
<td>Master Thesis Colloquium</td>
</tr>
<tr>
<td>Course Coordinator</td>
<td>NN</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester</th>
<th>Cycle</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td></td>
<td>deutsch/englisch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWS</th>
<th>Contact hours</th>
<th>Self-study hours</th>
<th>Workload in h</th>
<th>ECTS-Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Teaching form**
Presentation and discussion of the master thesis.

**Learning objectives**
The aim of the colloquium is to bring the students to be able to present the intermediate and final results of their work within a given length of time in a reasonable way.

**Description**
In the course of the accompanying colloquium, the students present the intermediate and final results of their master thesis and likewise take part in the discussions on other presented master thesis.

**Kind of examination**
Assessment of the master thesis together with the presentation of the colloquium.

**Literature**
Imprint

University of Duisburg Essen
Faculty of Engineering
Coordinator: Prof. Dr.-Ing. Holger Hirsch
Street: Forsthausweg 2
City: 47057 Duisburg
Phone: 0203 379 3370
Fax: 0203 379 2833
E-mail: hirsch@ieea.uni-duisburg.de

Legally binding is only the exam regulation.

Legend

WS  Winter Semester
SS  Summer Semester
SWS Contact hours per week
Cr.  Credits
V  Lecture
Ü  Exercise
P  Laboratory
S  Seminar
d  German
e  English