Program of studies in Electrical Engineering in the ECTS European Credit Transfer System

SOCRATES

ERASMUS European Community Action Scheme for the Mobility of University Students
Contents

ECTS - GENERAL INTRODUCTION  4

INFORMATIONS ABOUT THE TECHNISCHE UNIVERSITÄT DRESDEN  5
  Institution
  General Description
  Academic year

INFORMATIONS ABOUT THE DEPARTMENT OF ELECTRICAL ENGINEERING AND INFORMATION TECHNOLOGY  6
  ECTS Coordinator  6
  Laboratories in the Department  7
  Structure of studies in the program Electrical Engineering  8

OVERVIEW OF COURSES IN THE PROGRAM OF ELECTRICAL ENGINEERING  9
  Courses of Basic Studies  9
  Compulsory Courses in the Main Studies  11
  Optional Courses in the Main Studies - Scheme of the modules  16

SYLLABI OF COURSES  41
  Introduction into offered courses  41
  Courses offered by the Department EI  42
  12 01 Laboratory of Automation  42
  12 02 Laboratory of Electrical Power Engineering  50
  12 03 Laboratory of Control Theory  62
  12 04 Lab. of Electrical Power Systems and High Voltage Engineering  67
  12 05 Laboratory of Electromechanical and Electronic Design  74
  12 06 Electronics Packaging Laboratory  78
  12 07 Laboratory of Biomedical Engineering  86
  12 08 Laboratory of Circuits and Systems  90
  12 09 Laboratory of Acoustics and Speech Communication  100
  12 10 Communications Laboratory  110
  12 11 Laboratory for Solid-State Electronics  127
  12 12 Semiconductor and Microsystems Technology Laboratory  130

Courses offered by other departments  137
  00 01 Faculty of Science, Department of Mathematics  137
  00 02 Faculty of Science, Department of Physics  138
  00 03 Faculty of Computer Science  138
  00 04 Faculty of Mechanical Engineering  139
  00 05 Faculty of Transportation Engineering and Traffic Science "F. List"  141
ECTS - GENERAL INTRODUCTION

This information package describes the courses offered by Department of Electrical Engineering and Information Technology in order to help the prospective ECTS student to prepare for his/her study period in this institution.

What is ECTS?

ECTS, the European Community Course Credit Transfer System, was developed by the Commission of the European Communities in order to provide common procedures to guarantee academic recognition of studies abroad. It provides a way of comparing and measuring learning achievements, and transferring them from one institution to another.

The ECTS system is based on the principle of mutual trust and confidence between the participating higher education institutions. The few rules of ECTS, concerning Information (on courses available), Agreement (between the home and host institutions) and the Use of Credit Points (to indicate student workload) are set out to reinforce this mutual trust and confidence. Each ECTS department will describe the courses it offers not only in terms of content but also adding by credits to each course.

The ECTS credits

ECTS credits are a value allocated to course units to describe the student workload required to complete them. They reflect the quantity of work each course requires in relation to the total quantity of work required to complete a full year of academic study at the institution, that is, lectures, practical work, seminars, private work - in the library or at home - and examinations or other assessment activities. ECTS credits express a relative value.

In ECTS, 60 credits represent the workload of a year of study; normally 30 credits are given for a semester and 20 credits for a term. It is up to the participating institutions to subdivide the credits for the different courses. Practical placements and optional courses which form an integral part of the course of study also receive academic credit. Practical placements and optional courses which do not form an integral part of the course of study do not receive academic credit. Noncredit courses may, however, be mentioned in the transcript of records.

Credits are awarded only when the course has been completed and all required examinations have been successfully taken.

ECTS students

The students participating in ECTS will receive full credit for all academic work successfully carried out at any of the ECTS partner institutions and they will be able to transfer these academic credits from one participating institution to another as long as there is prior agreement between the institutions involved.

All students of the participating departments who are willing to take part in the ECTS scheme may do so if their institution agrees and within the limit of available places.

Most students participating in the ECTS pilot scheme will go to one host institution in an EU Member State country, study there for a limited period and then return to their home institution. Some may decide to stay at the host institution and finish their degree there. Some may also decide to proceed to a third institution to continue their studies. In each of these three cases, students will be required to comply with the legal and institutional requirements of the country and institution where they take their degree.

When the student returns and has successfully completed the study programme previously agreed between the home and host institutions, credit transfer will then take place, and the student will continue the study course at the home institution without any loss of time or credit. If, on the other hand, the student decides to stay at the host institution and to take his/her degree there, he/she may have to adapt his/her study course due to the legal, institutional and departmental rules in the host country, institution and department.
Students selected by each institution to participate in ECTS may only be awarded a student mobility grant if they fulfill the general conditions of eligibility for the SOCRATES grant. These are:

- students must be citizens of one of the EU member states (or recognized by one member state as having an official status of refugee or stateless person or permanent resident).
- students shall not be required to pay tuition fees at the host institution; the student may, however, be required to continue to pay his/her normal tuition fees to the home institution during the study period abroad;
- the national grant (e.g. "Bafög" in the Federal Republic of Germany) to which a student may be entitled for study at his/her institution may not be discontinued, interrupted or reduced while that student is studying in another Member State and is receiving an ERASMUS grant;
- one study period abroad should not last less than three months or more than one year;
- students in the first year of their studies are not eligible for receiving SOCRATES grants.

INFORMATIONS ABOUT THE TECHNISCHE UNIVERSITÄT DRESDEN

Institution
Technische Universität Dresden
Mommsenstraße 7
D-01062 Dresden

Phone +49 351 463-0
(int): http://www.tu-dresden.de

Informations of the International Office to ECTS with:
http://tu-dresden.de/internationales/ects

General Description
The Technische Universität Dresden (Dresden University of Technology) is one of the oldest technical universities in Germany and is justifiably proud of its fine tradition in education. The large campus just south of the city centre and also the extended area of the Department of Medicine form integral parts of the city of Dresden. Originally founded as a technical school in 1828, it was awarded the status of a Technical Academy in 1890 and in 1961 it was recognized as a University of Technology.

The Technische Universität Dresden consists of fourteen departments:

- Mathematics and Science (with the fields: Biology, Chemistry, Mathematics, Physics, Psychology)
- Philosophy
- Linguistics, Literature and Cultural Studies
- Education Science
- Law
- Business Management and Economics
- Electrical Engineering and Information Technology
- Computer Science
- Mechanical Engineering
- Civil Engineering
- Architecture
Transportation and Traffic Sciences  
Forestry, Geosciences and Hydrosciences  

Medicine

The department (Fakultät) is responsible for the correct realization of the respective courses of study. Departments usually consist of laboratories (Institute) that carry out teaching and research.

The student population at Dresden University of Technology counts at present more than 34,000 students, among them about 1500 foreigners from more than 100 countries.

Academic Year

The academic year is divided into a winter semester and a summer semester. Each semester includes 15 or 14 weeks for courses and 4 weeks for examinations. In addition, several weeks are intended for scientific work.

Winter semester: "W" 01 October - 31 March;  
Summer semester:"S" 01 April - 30 September

The courses of the winter semester start in the first week of October and last until the beginning of February. February is set aside for exams. The courses of the summer semester start in the first week of April and last until the end of July, followed by exams.

The Technische Universität Dresden (TUD) publishes an university calendar for each semester, called "Vorlesungsverzeichnis". This calendar indicates the courses of the respective semester, together with date, time and location and the names of the lecturer teaching the course. The information is also available via the WWW.

INFORMATIONS ABOUT THE DEPARTMENT OF  
ELECTRICAL ENGINEERING AND INFORMATION TECHNOLOGY

Technische Universität Dresden,  
Department of Electrical Engineering and Information Technology,  
(Fakultät Elektrotechnik und Informationstechnik)  
D-01062 Dresden

Dean: Prof. Dr.-Ing. Peter Schegner

Dean’s office: Helmholtzstr. 18, Barkhausen-Bau, room 154  
Phone: +49 351 463-32281, Fax: +49 351 471 39953  
Internet: http://www.et.tu-dresden.de/

ECTS-Coordinator  
Prof. Dr.-Ing. R. Lehnert  
Communications Laboratory (Institut für Nachrichtentechnik)  
Chair for Telecommunications  
Phone: +49 351 463-33942, Fax: +49 351 463-37163  
E-mail: erasmus@ifn.et.tu-dresden.de
Laboratories in the Department of Electrical Engineering and Information Technology

The department of Electrical Engineering and Information Technology is one of the largest of its kind in Germany covering all aspects of its area from power electronics to microelectronics and communications. The department consists of 12 laboratories (Institute).

<table>
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<th>English German</th>
<th>Abbreviation</th>
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<td>01</td>
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<td>02</td>
<td>Laboratory of Electrical Power Engineering Elektrotechnisches Institut</td>
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<td>03</td>
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<td>Laboratory for Solid-State Electronics Institut für Festkörperelektronik</td>
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<tr>
<td>12</td>
<td>Semiconductor and Microsystems Technology Laboratory Institut für Halbleiter- und Mikrosystemtechnik</td>
<td>SMTL IHM</td>
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</table>
Structure of studies in the program Electrical Engineering

The studies at the Department of Electrical Engineering and Information Technology consist of two stages, i.e.:
- **Basic courses**, which are completed with the intermediate examination after four semesters, as a rule, and subsequently
- **Main courses**, which are completed after six further semesters with the final diploma examination concluded by the diploma thesis.

**Attention:** Most of the lectures for the study of Electrical Engineering are given in German.

The course program Electrical Engineering offers studies in the branch areas:

- **Automation and Control Engineering**
  - Automatisierungs- und Regelungstechnik
  [2, 19, 20]

- **Electrical Power Engineering**
  - Elektroenergietechnik
  [4, 5, 6, 7, 12, 15]

- **Precision and Micro Engineering**
  - Feinwerk- und Mikrotechnik
  [1, 3, 8]

- **Communications and Information Technology**
  - Informationstechnik
  [11, 13, 14, 25]

- **Microelectronics**
  - Mikroelektronik
  [1, 8, 10, 17, 21, 22]

The numbers in brackets stand for the **Optional Modules** recommended to the branch on the left side, as proposals to fill the required amount of optional courses in the Main Study. All courses are named in the following overview and shown in the article Syllabi of Courses.
## OVERVIEW OF COURSES IN THE PROGRAM OF ELECTRICAL ENGINEERING

### COURSES OF BASIC STUDIES

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### Compulsory Courses in the Main Studies

L - hours of lectures/week/semester  
E - hours exercises/week/semester  
P - hours laboratory practical/week/semester

Special Field: **Automation and Control Engineering**  
Automatisierungs- und Regelungstechnik

#### Compulsory Courses

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**BACK TO PAGE: CONTENTS**

11
## Compulsory Courses

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Used Special Field: Micro electronics
Mikroelektronik
## Optional Courses in the Main Studies - Scheme of the Modules

### Optional Modulus 01: Electronics Packaging

**Aufbau- und Verbindungstechnik**

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$X^1$: optional in the 5th, or 7th semester

$X^2$: optional in the 6th, or 8th semester
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**Biomedizinische Technik**

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Elektrische Antriebe und Bewegungssteuerungen

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Geräte- und Informationstechnik für die Medizin

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| **Medical Terminology for Biomedical Engineers**
Medizinische Terminologie für Biomedizintechniker                                    | 1 0 0 | 6.   | 1.5     | 00 07 02      |
| **Ultrasonic I**
Ultraschall I (Physik des Ultraschalls)                                           | 2 0 0 | 7.   | 3       | 12 0915       |
| **Ultrasonic II**
Ultraschall II (Schallfeldmodellierung)                                           | 1 1 0 | 8.   | 3       | 12 0916       |
| **Ultrasonic III**
Ultraschall III (Besondere Methoden und Verfahren)                                | 2 0 0 | 7.   | 3       | 12 0917       |
| **Medical Equipment for Diagnostics**
Diagnostische Gerätetechnik                                                        | 2 0 0 | 7.   | 7.5     | 12 07 06      |
| **Medical Equipment for Therapy**
Therapeutische Gerätetechnik                                                         | 2 0 1 | 7.   | 7.5     | 12 07 07      |
| **Models in Biomedical Engineering**
Modelle in der Biomedizinischen Technik                                               | 2 0 1 | 8.   | 4.5     | 12 07 09      |

**BACK TO PAGE: CONTENTS**
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BACK TO PAGE: CONTENTS
### Optional modulus 11: High Frequency Techniques and Photonics

#### Deutsch

**Hochfrequenztechnik / Photonik**

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**Englisch**

- Antennas
- Propagation of Electromagnetic Waves
- Microwave Devices
- Satellite Location Systems
- Radar Technique and Satellite Borne Remote Sensing
- Direction Finding and Radio Navigation Systems
- RF Measurements and EMC
- Fundamentals of High Frequency Techniques II
- Optical Waveguides
- Numerical Field Calculation
- Photonics I
- Photonics II
- RF Laboratory Practices
- Fiber optic Communication Systems

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_BACK TO PAGE: CONTENTS_
### Optional modulus 12: High Voltage and High Current Engineering
Hochspannungs- und Hochstromtechnik

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BACK TO PAGE: CONTENTS
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### Optional modulus 18: Mobile Communications Systems

Mobile Nachrichtensysteme

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Schaltkreis- und Systementwurf

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BACK TO PAGE: CONTENTS
**SYLLABI**

**OF COURSES OFFERED IN THE PROGRAM OF ELECTRICAL ENGINEERING -**

**Introduction into offered courses**

**Attention:** Most of the lectures for the study of Electrical Engineering are given in German.

In the following, the offer of courses of lectures for the studies in electrical engineering is presented.

Each course of lectures is described as follows:

Procedure of presentation, as example:

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The courses are arranged according to the offering laboratories (institutes)
Courses offered by the Department EI

12 01

EI LA Laboratory of Automation
EI IFA Institut für Automatisierungstechnik

12 01 01 Automation Engineering  
(Automatisierungstechnik)

EI LA S 2 1 0 4.5 cr

This course aims to study basic principles and methods for the automatic control of technical processes.

Lectures include:

- elementary systems modelling concepts
- quantitative description (mathematical models, linear time-invariant (LTI) systems, block and signal flow diagrams, Laplace-transformation, transfer function, impulse/step response, manipulation of block diagrams, frequency response, BODE-diagrams)
- time behaviour and stability (LTI-system properties, BIBO-stability, closed loop systems, Hurwitz-criterion, Nyquist-criterion, stationary/ transient behaviour)
- control system design in frequency domain (open loop and feedback properties, controller synthesis with BODE-diagrams)
- digital control (sampling, aliasing, hold device, discrete frequency response, digital controllers, design of digital controllers with Bode-diagrams)
- industrial standard controllers (PID, corrective properties, realization variants, selected controller tuning rules)
- discrete event control (basic properties of discrete event systems, signal models, binary systems, combinatorial automata, sequential automata, signal-based design of a discrete event controller, realization aspects)
- problem solving control structures (direct/model-based measurement, observer, model-based failure detection, open-loop / feedback / cascade / adaptive / redundant control)
- automation technologies (trends, process control structures, industrial control languages - standard IEC 1131, real-time aspects, serial bus systems, internet in automation)

Complementary exercises on selected automation and control problems augmented by Matlab/Simulink models allow to train practical skills on modelling, analysis and design.

examination: written  
language: German

prerequisites: system theory

lecturer: Janschek, Giebler

12 01 02 Microcomputer Technology 1  
Mikrorechentechnik 1

EI LA W 2 0 1 4.5 cr

This course provides a step-by-step introduction to programming of microcontrollers. The following topics will be covered: Architecture and functional principles of microcontrollers and microprocessors, Assembly Language Programming (Mnemonics, and macros,
register, memory and stack access, flow control, subroutines, interrupts and interrupt service routines), C Programming Language (preprocessor, data types, flow control, data structures, arrays and pointers), interfacing and programming of peripheral components. Students deepen their understanding in three laboratory exercises (von Neumann Simulator, Assembler, C).

examination: Oral in the laboratory
prerequisites: Basics of informatics (Computer Science 1, 2)
lecturer: Urbas

12 01 03 Microcomputer Technology 2
Mikrorechentechnik 2

EI LA S 1 0 2 4.5 cr

This course gives an introduction to the fundamentals of object oriented programming of micro controller applications with the C++ programming language (classes, objects, methods, specialization and polymorphic methods, operator overloading, templates and the standard template library), structured signal processing by function blocks, interfacing and programming of hardware components with C++. Students learn to apply and improve their programming skills and knowledge in laboratory exercises held in different departments.

examination: Oral in the laboratory
prerequisites: Microcomputer Technology 1
lecturer: Urbas

12 01 04 Control of Discrete Processes
Steuerung diskreter Prozesse

EI LA W 2 1 0 S 2 0 1 9 cr

This course aims to study basic methods for modelling and analysis of discrete event automation systems and to become familiar with industrial software technologies for implementation.

Lectures Part 1
introduction to discrete event systems, signal oriented modelling, combinatorial automata, sequential automata, Petri-nets, time stamped Petri-nets (max-plus algebra notation), discrete event control systems design, realization aspects

Lectures Part 2
hybrid systems (discrete event – continuous), modelling with statecharts, discrete event motion control, industrial control software technology (EN 61131-3 languages), advanced max-plus design of time-stamped Petri-nets.

Complementary exercises on hands-on examples allow to train practical skills in modelling, analysis and design.

Laboratory exercises familiarizes with the use of EN 61131-3 languages and discrete event motion control systems.

examination: written
prerequisites: system theory
lecturer: Janschek, Hofmann, Koycheva
12 01 05  Modelling and Simulation  
Modellbildung und Simulation  
EI LA  S  2 2 0  6 cr  
- Content is under construction.  
examination:  
prerequisites:  
lecturer:  Giebler

12 01 06  Distributed Control Systems  
Prozessrechentechnik und Prozessleittechnik  
EI LA  S  4 0 1  6 cr  
This course introduces the fundamentals of modern distributed control systems. The following topics are covered: micro controller, real time processing, programmable logic control, automation architectures, digital fieldbus communication, ethernet based communication, safety and security, reliability and availability methods, human machine interaction, PLS integration technologies, middleware layers, management execution systems, agent technologies, methods and tools for process control systems engineering.  
examination:  Written  
language:  German  
prerequisites:  
lecturer:  Urbas

12 01 07  Systems Design  
Systementwurf  
EI LA  W  2 1 0  4.5 cr  
Aim of this course is to study basic methods and techniques for the system design of complex automation solutions including the evaluation of design options. Lectures: methods of requirements analysis and specification, system modelling with structured analysis, object oriented analysis, project management, quality management, safety and reliability. Complementary practical exercises familiarize with skills on the complete development cycle of an automation solution from the requirements analysis to the implementation by using the design methods (e.g. mobile robot control functions).  
examination:  written  
language:  German  
prerequisites:  basics in process control systems  
lecturer:  Janschek/Braune

12 01 08  Mechatronic Systems  
(Mechatronische Systeme)  
EI LA  W  2 1 0  4.5 cr  
This course aims to study how to model and analyse quantitatively the functional interdependencies of mechatronics systems including multi-body mechanics, electrodynamics, piezoelectrics, hydraulics, information processing, special control problems
(collocation of sensors and actuators, aliasing), simulation, stochastic signal sources and performance budget assessment.

Complementary exercises on selected mechatronics problems augmented by Matlab/Simulink models allow to train practical skills on modelling and analysis.

**examination:** written  
**language:** German  
**prerequisites:** automation engineering, mechanics (dynamics)  
**lecturer:** Janschek, Beck

### 12 01 09  
**Project Planning for Process Automation Systems**  
(Projektierung von Automatisierungssystemen)

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The lecture provide fundamental skills and abilities for a methodological and systematic planning of modern automation architectures. Based on a „Desktop Automation Laboratory (DAL)“ the following topics are considered: Development of Piping and Instrument diagram (PID) for exemplary subsystems (continuous and discrete event processes), selection of automation instruments, design of control algorithms and start up of the (continuous and discrete event) processes.  
In addition the connection of Control -, Manufacturing Execution System – and Enterprise Resource Planning – plane is demonstrated.

**examination:** written  
**language:** German  
**prerequisites:** basics of automation, basics in selection of the automation instrumentation  
**lecturer:** Hofmann

### 12 01 10  
**Discrete Event Systems**  
(Ereignisdiskrete Systeme)

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This course aims to study basic methods for modelling and analysis of discrete event automation systems.  
Lectures  
introduction to discrete event systems, signal oriented modelling, combinatorial automata, sequential automata, Petri-nets, time stamped Petri-nets (max-plus algebra notation), discrete event control systems design, realization aspects  
Complementary exercises on hands-on examples allow to train practical skills in modelling, analysis and design.  
**Note:** this course covers actually the winter term of the course Control of Discrete Processes

**examination:** written  
**language:** German  
**prerequisites:** system theory  
**lecturer:** Janschek, Hofmann, Koycheva

### 12 01 11  
**Programming in Visual C ++**  
(Programmierung mit Visual C++)

| EI | LA | S 200 | 3 cr |

- **Content is under construction.**
12 01 12  Bus systems in Automation
Bussysteme in der Automatisierungstechnik

EL LA W 200 3 cr

- Content is under construction.

12 01 13  Programmable Logic Controller and Industrial Controllers
SPS und Kompaktregler

EL LA W 200 3 cr

Functional principles, design methods, logic control patterns, programming and test methods for programmable logic controllers and industrial PID-controllers are the topics of this course. After a short historical review and a repetition of the basics of logic and logic design methods the main topic is the abstract PLC-Standard as defined in IEC 61131 (however Siemens S7/PCS7 issues are handled as well). This is completed by logic control patterns and methods for effective and efficient PLC programming and testing. The second part of the lecture switches to the topic of digital industrial controller: After having repeated the basics like z-transform and digital filtering we will go into the details of integrating a PID control algorithm into an industrial environment.

12 01 14  Advanced Seminar Mobile Robotics
Oberseminar Mobile Robotik

EL LA W 200 3 cr

Autonomous planetary robots in astronautics, mobile cleaning robots or electronic pets – autonomous mobile robots capture more and more markets in the public life. This seminar introduces the fundamentals of mobile robotics. The following topics will be covered: sensing (gyroscope, infrared and ultrasonic sensors, laser rangefinders, camera), qualitative and quantitative algorithm of localization and navigation, metrical and topological maps and further different types of locomotion. The seminar is composed of initial lectures, work on the term paper and a final design concept for a given application. The results of the term paper and the design concept have to be displayed in a presentation.

examination: term paper  language: German
prerequisites:  mathematics, physics
lecturer: Janschek, Horn
**12 01 15**  
**Control of Robot Manipulators**  
Steuerung von Robotersystemen

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| This course aims to study basic methods for modelling and control of robot manipulation systems. The topics covered comprise: introduction to industrial robots, direct (forward) kinematics, inverse kinematics, trajectories, differential kinematics (Jacobi-matrix), manipulator dynamics, position control, force control.  
Accompanying exercises augmented by Matlab models familiarize with practical modelling, analysis and design skills.  

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<tr>
<td>language:</td>
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<tr>
<td>prerequisites:</td>
<td>automation and control, mechanics (dynamics)</td>
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<td>lecturer:</td>
<td>Janschek, Reimann</td>
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**12 01 16**  
**Application of Internet Technology in Automation**  
Internet-Anwendungen in der Automatisierungstechnik

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| This course aims to acquire basic knowledge of relevant internet technology for automation solutions and their advantages and risks for automation.  
Lectures: Industrial Ethernet  
TCP/IP Protocol  
standard internet services such as WEB and OPC  
Complementary practical exercises familiarize with the application of some typical document and programming languages such as Java, HTML, XML for monitoring and control of process values.  

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<tr>
<td>prerequisites:</td>
<td>basic knowledge in process control systems and fieldbus systems</td>
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<td>lecturer:</td>
<td>Braune</td>
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**12 01 17**  
**Spacecraft Attitude and Orbit Control**  
Lageregelungssysteme für Raumfahrzeuge

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| This course aims to study basic principles and system concepts for attitude and orbit control of spacecraft with the main focus on earth orbiting satellites.  
Lectures: Introduction (missions, spacecraft types, requirements, typical control problems); Orbit Dynamics (Keplerian orbits, orbit types, perturbations, orbit maintenance); Attitude Kinematics (coordinate frames, attitude representations: direction cosine matrix, Euler angles, quaternions); Attitude Dynamics (Euler equations, environmental disturbance torques); Attitude Determination (vector measurements, state propagation, filtering); Attitude Sensors (optical, inertial, magnetic); Attitude Control Concepts (including discussion of basic actuation hardware): Spin Stabilization, Gravity Gradient Stabilization, Magnetic Control (magnetic torques), Bias Momentum Control (momentum/reaction wheels), Thruster Control; System Engineering Elements.  
Complementary exercises on selected attitude control problems augmented by Matlab/Simulink models allow to train practical skills on modelling, analysis and design.  

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<tr>
<td>prerequisites:</td>
<td>physics, mathematics, basics of control theory</td>
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<tr>
<td>lecturer:</td>
<td>Janschek, Dyblenko</td>
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**12 01 18  Project Teleautomation**  
Projekt Teleautomation

**EI LA W 0 0 2 3 cr**

Aim of the project is to gather practical experiences in using internet technologies for automation solutions. In groups of about 3-4 students special aspects of internet technologies are being analyzed and internet based automation solutions are developed. The students have to cover the whole life cycle of the product development from requirements analysis to implementation and test.

examination: project report, oral  
language: German

prerequisites: internet technology in automation

lecturer: Braune

**12 01 19  Project – Automation for Process Plants**  
Projekt–Automatisierung Verfahrenstechnik

**EI LA S 0 0 2 3 cr**

The goal of the project is the acquisition of knowledge and skills for the design, start up and commissioning of a complete automation system. The scientific and practical tasks based on a Desktop Automation Laboratory (DAL with modern IT-components (programable controller S7-400S™/ process control system WinCC™). The design and the start up of the subsections, i.e., Level, Flow and Temperature, using the results of theoretical and experimental process analysis.

examination: oral  
language: German

prerequisites: Projekt Planning for Process Automation Systems

lecturer: Hofmann

**12 01 20  Produktionintegrierter Umweltschutz - Automatisierungsprobleme**

**EI LA W, or S 2 0 0 3 cr**

- Content is under construction.

examination:  
language: German

prerequisites:  
lecturer: Janschek

**12 01 21  Praktikum Industrielle Automatisierungsmittel**

**EI LA W 2 0 0 3 cr**

- Content is under construction.

examination:  
language: German

prerequisites:  
lecturer: Janschek
12 01 22  Computer Aided Engineering of Automation Systems  
CAE für die Leittechnik

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This course gives an introduction to computer aided engineering methods for automation systems. The lectures on information modelling, CAE architectures, automation engineering tasks, documents and drawings, information exchange between different tools and workshops and engineering process management are paralleled by practical exercises with current object oriented industrial CAE tools.

- examination: Oral
- language: German
- prerequisites: Process Control Systems, Computer Science 1 + 2
- lecturer: n.n.

12 01 23  Human-Machine Interaction
Mensch-Maschine-Interaktion

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During this course students will learn the fundamentals of designing, implementing and evaluating human-machine-interfaces for complex applications. Topics include human perception and cognition, general and domain-specific design recommendations and usability guidelines as well as user participation and interface evaluation. The theoretical foundations are applied to current interface design problems.

- examination: Oral
- language: German
- prerequisites: 
- lecturer: Urbas
12 02 01  Theoretical Electrotechniques I and II  
Theoretische Elektrotechnik I und II

Content:
Vector analysis with grad, div and curl, Maxwell’s equations, boundary conditions, sentence of Poynting, static field with direct solution and solution of the Laplace integral equation, stationary field with the introduction of the magnetic vector potential, quasistationary field (eddy currents), transmission line theory in frequency range, dynamic field with plane waves, elementary dipoles, wave guides

examination: Written, 135 min.  
language: German

prerequisites: mathematics, physics, basics in electrotechnique

lecturer: Gonschorek

12 02 02  Electric and Hydraulic Actuators  
Antriebstechnik

Electric and hydraulic actuators generate motion and allow the controlling of the power flow from the mostly electric power source to different mechanical equipment. This compulsory course introduces to the typical tasks for actuators.

Part 1  Electric drives and the drive system: Different types of motion, embedding of the actuator in the environment, fast generation of torque in rotation electrical machines of force in linear motors, natural and controlled speed-torque-behavior, principles of drive control, thermal and mechanical design of drives.

Part 2  Hydraulic drives and their control: Principles of value-controlled hydraulic drives, introduction into the behavior of hydraulic valves, design of continuous changeable hydraulic valves and servo-cylinders for controlled hydraulic actuators, controlled system for electro-hydraulic control, closed loop control of hydraulic actuators.

Numerical exercises complement the lectures in both parts. Four laboratory tasks allow the students to see electric and hydraulic actuators working.

examination: written  
language: German

prerequisites: basics in electrotechnique

lecturer: Geitner / Helduser

12 02 03  Technical Systems  
Technische Systeme

The course is a specialized introduction into automation for electrical power engineering students. Important methods for the modelling, analysis, identification and design of uncontrolled and controlled systems are provided. Main points of the course are: event-
driven systems, cascade and state space control for continuous systems, discrete time systems and digital control. Nonlinearities, robustness, adaptation and self-tuning of controllers are further topics of lectures and exercises.

Four laboratory exercises show the students the verification of the learned principles: Event-driven open-loop control, experimental parameter identification, digital filter and controller, Optimization in closed loop control.

**Examination:** written language: German

**Prerequisites:** intermediate examination

**Lecturer:** Büchner

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**12 02 04 Electrical Machines 1**
Elektrische Maschinen 1

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The lectures shall provide the knowledge and understanding of the principles of electro-mechanical energy conversion and the design features, parameters, performances and application of the basic electrical machine types, i.e transformer, three phase synchronous and asynchronous machine and DC-machine. Adapted to the lectures exercises on calculation and laboratory work are integrated for intensified learning by doing.

**Examination:** written, 4 hours language: German

**Prerequisites:** basics in electrical engineering

**Lecturer:** Liese

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**12 02 05 Electrical Machines 2**
Elektrische Maschinen 2

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Based on the fundamentals of rotating electrical machines of the lecture Electrical Machines 1 specific types of synchronous, asynchronous and DC machine preferably used as prime movers in industry and electrical drives are comprised. Attention is put on special problems of induction machines such as field harmonics and voltage harmonics due to inverter fed operation. Finally, the fundamentals of Park's theory are introduced as well as numerical field calculation methods for advanced application on electrical machine problems. Adapted to the lectures calculation exercises are integrated for intensified learning by doing.

**Examination:** written, 4 hours language: German

**Prerequisites:** basics in electrical machines

**Lecturer:** Liese

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**12 02 06 Fundamentals of Power Electronics**
Leistungselektronik 1

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This course of lectures provides basic knowledge of power semiconductor devices (Power Diodes, BJT, Power MOSFET, Thyristor, GTO-Thyristor, IGBT, MCT, SIT), convertor configurations (line-frequency phase-controlled rectifiers and inverters, PWM-inverters, dc-chopper) and firing-control systems. In exercises and a practical, the various power electronic components and convertor configurations will be examined and analysed.
12 02 07  Electric Drives
         Elektrische Antriebe

EI LEPE S  3 1 0    6 cr

This course introduces in the configuration and the design of electric drive systems. The task of electric drives is to generate motion. Therefore electrical energy has to be converted into mechanical energy. The principles of motion generation, of power flow and of conversion as well as the signal flow for power and motion control are on the agenda. The general steady-state and dynamic behaviour of electrical machines and their interactions with the power electronics, the mains and the mechanical environment are provided. The course includes natural uncontrolled behaviour of dc- and ac drives and especially artificial behaviour by means of closed loop control. A special main point is the dynamic behaviour of ac drives fed by inverter systems. The course is finished with chapters dealing with servo-drives, communication between decentralized drives and electric traction.

examination: written  language: German
prerequisites: basic study of electrical engineering or mechatronics, technical systems
lecturer: Büchner

12 02 08  Laboratory Electric Drives
         Praktikum Elektrische Antriebe

EI LEPE W  0 0 2    3 cr

The knowledge obtained in the course electrical drives can be proved in six laboratory tasks. All tasks are executed at modularized universal laboratory stands, where a machine set consisting of a dc-machine and an ac-asynchronous machine with slip-rings is fed by a three-phase mains with different short circuit power via power electronic converters. The test stand is equipped with fast fied bus communication and different types of digital controllers.

Content of the tasks: motion control, parameter estimation, behaviour of ac drives, speed control of dc-drives, frequency control of ac-drives, mains interferences of drives

examination: belongs to the course electrical drives  language: German
prerequisites: course electric drives
lecturer: Büchner et al.

12 02 09  Electromagnetic Compatibility (EMC)
         Elektromagnetische Verträglichkeit (EMV)

EI LEPE W  2 0 1    4.5 cr

Content:
Natural noise sources, man made noise, the interference model, galvanic, capacitive, inductive and electromagnetic coupling and measures against, shielding theory of Kaden and of Schelkunoff, leakages in electromagnetic shields, standing waves, shielding materials, test methods, introduction to the EMC-standardization, practical and theoretical exercises
12 02 10 Power Electronics II
Leistungselektronik II
EI LEPE S 2 1 0 W 1 0 1 7.5 cr
The course provides a comprehensive knowledge of power electronic circuitry and systems. Various power converter topologies are presented including: Line frequency controlled Converters (continuous and discontinuous mode, ripple, harmonic distortion), Direct Converters, Matrix Converters, Load commutated Converters, DC Chopper, Switch Mode Power Supplies (Buck, Boost, Cuk, Full-Bridge), Resonant Converters (ZVS, ZCS), CSI/VSI (1 phase/3 phase, 2 level/3 level topology). Control strategies for each topology are discussed focusing on pulse pattern (Natural PWM, Square Wave, Space Vector, Hysteresis Band), device protection, fail-safe operation, and system behavior. Special attention is given to power quality, utility disturbance and EMI. Practical design solutions utilizing microprocessors are shown as well as problems related to specific applications (electric vehicles, photovoltaics, railway converters).
Both, analysis and design of power converter configurations are supported by simulations (PSPICE, SIMPLORER) and laboratories. Laboratory tests are also based on recent research in the fields of PV applications, power converters for railway traction, power conditioners etc. Additionally, a final project investigates problems of power converters in electric traction application.

examination: oral
language: German
prerequisites: basic in power electronics, electrical drives
lecturer: Güldner

12 02 11 Application-specific Real-Time Controller
Anwendungsspezifische Echtzeitregler
EI LEPE S 2 1 0 4.5 cr
Main focus is the application of methods and tools for design and realization of application specific digital real-time controller:
quasi-continuous computation – tools, methods; description basics of sampled control – systematic modelling, sample-block-diagram-method, applied Z-transformation; Digital Amount Optimum – basics, examples; deadbeat control – basics, suboptimal control, reference and disturbance variable; control of several variables – basics, approximated and precise computation; limitations – several methods, graphical programming; use of MATLAB / SIMULINK – examples; bond graphs – basics, examples, application hints.

examination: oral or L
language: German
prerequisites: Laplace- and Z-Transformation, basics of MATLAB / SIMULINK
lecturer: Geitner

12 02 12 Low power Electrical Machines
(Elektrische Kleinstmaschinen)
EI LEPE W 1 1 1 4,5 cr
The course of lectures provides a survey of low power electrical machines, their application
and electronic devices for supply and control.
The subjects are combined with exercises of calculation and laboratory work.

examination: oral
prerequisites: basics in electrical machines
lecturer: Liese

**12 02 13 Design of Drive Systems**
Entwurf von Antriebssystemen

EI LEPE W 2 1 0 4.5 cr

The participants of this lecture course will be introduced to the methods of simulation and the computer-aided system design in the field of electrical drives. On the one hand they should broaden and extend their knowledge about modelling in electrical engineering and on the other hand get to know the principles of digital simulation. As the result they will be able to select and apply suitable tools to solve problems typically for this special field. The simulation forms an essential part of the modern computer-aided design studies. All steps beginning from the simulation studies and ending with the implementation of the control algorithms in the control device will be presented. An other main focus leads to the introduction to the hardware and software structure of digital control units with microcontrollers (MC) or digital signal processors (DSP). Detailed skills are an essential presumption for a successful implementation of the control algorithms.

examination: oral
prerequisites: basic study in mechatronics, participation in module motion control
lecturer: V. Müller

**12 02 14 Mains Interferences of Power Converters**
Stromrichter-Netzrückwirkungen

EI LEPE W 1 1 1 4.5 cr

Mains interferences caused by power converters can be the source of incompatibilities or failures in industrial or domestic systems. Mains interferences belong to the line-conducted low-frequency EMC. The lecture introduces in the main phenomena of disturbances and gives physical and mathematical models for the interactions between converters and the feeding mains at the point of common coupling. The description of the phenomena with characteristics, based on international EMC-standards (IEC 61000) are given. Measures to mitigate the disturbances and to guarantee compatibility are introduced. The most important measures are mains-friendly converters and compensation of disturbances by means of active filters with PWM-converters.

examination: oral
prerequisites: power electronics and electric drives
lecturer: Büchner

**12 02 15 Motion Control**
Bewegungssteuerung

EI LEPE S 2 1 2 7.5 cr

Motion control is the main task in servo-drives. Starting with the components of controlled drives: motion sensors, actuators, mechanical transfer equipment typical technological tasks of motion control are provided. The main topic is the realization of the field-oriented
control of ac-drives by means of microcontrollers. Other topics are: multi-motor drives and synchronization of several motions, communication with field-bus systems, adaptive motion control and self-tuning control. The knowledge obtained in the course can be proved in a six laboratory tasks: hybrid function chard, fast torque control, DSP for motion control, position control, PMSM as servo-drive, set in run procedure for a servo-drive, motion control with PLC examination: oral language: German prerequisites: technical systems, electric drives lecturer: Büchner

12 02 16 Electro-Machine Dynamics Elektromaschinendynamik

EI LEPE W 1 1 0 3 cr
The lecture deals with models, numerical methods and programmes for simulating the transient performance of electrical machines. Learning by doing is incorporated due to simulation examples such as quick starting of induction motors.

examination: oral language: German
prerequisites: fundamentals of Electrical Machines 2
lecturer: Liese

12 02 17 Transformers and Instrument Transformers Transformatoren und Messwandler

EI LEPE W 2 1 0 S 0 0 2 7.5 cr
The course presents theoretical and practical aspects of the performance and design of power transformers and instrument transformers. With respect to instrument transformers problems of accuracy are considered. The subjects are combined with exercises of calculation and laboratory work.

examination: oral language: German
prerequisites: basics in electrical machines
lecturer: Liese/Ermisch

12 02 18 Practical Electronics Praktische Elektronik

EI LEPE S 1 0 0 1.5 cr
The course presents special aspects of electronic circuits used in electrical power engineering. Problems of circuit design and the usage of modern components and sensors are considered.

examination: oral language: German
prerequisites: basics in electrical engineering
lecturer: Ermisch
12 02 19  Numerical Field Calculation
Numerische Feldberechnung

EI  LEPE  W  2 1 1  6 cr

Content:

examination: oral  language: German
prerequisites: mathematics, physics, theoretical electrotechnique
lecturer: Gonschorek

12 02 20  Applied Numerical Field Calculation
Angewandte numerische (Magnet-)Feldberechnung

EI  LEPE  S  1 0 2  4.5 cr

In the lecture, the students are enabled to solve practical field-problems by means of numerical field-calculation. The following topics will be covered:
Fundamentals of the Finite-Element-Method; the FEM-Software ANSYS®; Generation of the FE-Modell (Preprocessor); Numerical solution (Solver); Evaluation of the results (Postprocessor); Calculation of nonlinear magnetic circuits; time-depending magnetic fields; three-dimensional calculation of magnetic fields;

examination: practical  language: German
prerequisites: Principles of Electrical Engineering.
lecturer: Binner

12 02 21  Propagation of Electromagnetic Waves
Ausbreitung elektromagnetischer Wellen

EI  LEPE  S  2 0 0  3 cr

This course contains the basics of wave propagation for communication. The following topics will be covered: free space propagation, Fresnel-Ellipsoid, reflection, scattering, diffraction and attenuation of electromagnetic waves, surface and ionosphärical wave propagation, waves in troposphere and ionosphere, multi-channel propagation, Doppler-Effekt, statistical description of propagation channels, noise in propagation channels.

examination: oral  language: German
prerequisites: Theoretical Electrodynamics
lecturer: Gonschorek/Plettemeier
12 02 22  PCB-Layout under EMC-constraints
EMV-gerechte Schaltungsauslegung

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| The course starts with refreshing the basics of EMC, which are electromagnetic coupling and counter measures in general. The main topics of the lecture are: sources and victims of electromagnetic disturbances on PCB’s, grounding systems (analog, digital, power supply), high-frequency behavior of discrete elements (lines, R, L, C), PCB-Layout with respect to EMC, decoupling and interference suppression, influence of the IC-technology and its switching behavior, signal integrity, line termination and EMC-aspects in µ-processor applications.

examination: written  language: German
prerequisites: Principles of electrical engineering, principles of high-frequency engineering, circuit technology engineering
lecturer: Gonschorek/Zschau

12 02 23  Low frequency magnetic fields
Niederfrequente Magnetfelder

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| - Content is under construction.

examination:  language: German
prerequisites:  
lecturer:  

12 02 24  Linear antennas and transmission lines
(Linearantennen und Leitungen)

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</table>
| Content: Solution of Maxwell’s equations for radiation problems, the Hertzian and the magnetic dipole, linear antennas, antenna quantities, field impedance, radiation resistance, the effective antenna height and the effective antenna area, the radiation diagram, the receiving antenna, repetition of the transmission line theory, field coupling into horizontal lines above lossy ground, coupling of plane wave, impulse coupling

examination: oral  language: German
prerequisites: mathematics, physics, theoretical electrotechnique
lecturer: Gonschorek

12 02 25  Practical course: EMC
Praktikum EMV

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</table>
| Practical exercises from the field of EMC:
1. Coupling between transmission lines
2. Filtering to suppress conducted interference signals
3. Electromagnetic coupling
4. Description of the shielding efficiency of an shielded enclosure by applying a standardised method

examination: questions at the end of each exercise
language: German
prerequisites: basic knowledge in EMC
lecturer: scientific staff of the EMC-chair

12 02 26 Drive Systems
Antriebssysteme

EI LEPE W 2 1 0 4.5 cr
Based on lectures "Electrical Power Engineering" and "Precision Drives" knowledge will be extended regarding operational behaviour, dimensioning and design of electric drives: description of motion processes – time sequence charts, circuit diagrams, hybrid function charts; dimensioning of electric motors- operating point, thermal dimensioning, load conversion; power electronic sources – typical circuits; electric motors as a controlled system – basics, functional block diagram; electric drive control – continuous, quasi-continuous, discontinuous; bond graphs – basics, examples.

examination: oral or L
language: German
prerequisites: Laplace- and Z-Transformation
lecturer: Geitner

12 02 27 Antennas
Antennen

EI LEPE S 2 1 0 4.5 cr
This course provides basic knowledge of antenna theory and design. On the basis of the radiation field characteristics, the elementary radiation sources, and the array antennas the lectures introduce the fundamentals of the important antennas (linear antennas, aperture antennas, frequency-independent antennas, microstrip antennas). In exercises, knowledge provided by the course of lectures is increased.

examination: written
language: German
prerequisites: electromagnetic fields; radio and microwave engineering
lecturer: Plettemeier

12 02 28 Radar Technique and Satellite Borne Remote Sensing; Fundamentals and Application
Grundlagen und Anwendung der Radartechnik und der satellitengestützten Fernerkundung

EI LEPE S 2 0 0 3 cr:
This lecture introduces design, functioning and characteristic features of widely-used Radar systems for ground based and satellite born applications in remote sensing. Handling of Radar equation, estimation of electromagnetic wave propagation effects and model based analyses of surface and volume scattering are further objectives of this course. Included topics: Pulse Radar, continuous wave (CW) and frequency modulated continuous wave (FMCW) Radar, Doppler Radar, primary and secondary Radar (air traffic control), antennas in Radar applications, Radar equation, Radar cross section, scattering coefficient, target recognition and tracking, range and velocity measurements, surface and volume
scattering, satellite and space born systems for Radar remote sensing, synthetic aperture Radar (SAR), subsurface sounding and ground penetrating Radar.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Exam</th>
<th>Prerequisites</th>
<th>Lecturer</th>
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<tbody>
<tr>
<td>12 02 29</td>
<td>Direction Finding and Radio Navigation Systems</td>
<td>oral</td>
<td>mathematics, physics, basics of electromagnetic theory and high frequency technique</td>
<td>Plettemeier</td>
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**12 02 29 Direction Finding and Radio Navigation Systems**
Funkortungs- und Navigationssysteme

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<tr>
<th>EI</th>
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| This lecture provides fundamental knowledge of design and functioning of radio systems used in direction finding and radio navigation. System-related features will be discussed by the means of ground based and on-board surveillance systems (e.g. air and maritime traffic control).
Covered topics: System classification, frequency ranges, wave propagation effects, transmitter and receiver of radio systems, antennas, noise and interferences, ground based systems, cooperative systems, VHF omni range (VOR) and Doppler-VOR beacon systems, distance measuring equipment (DME), differential range measurements, long range navigation (LORAN), on-board systems, Doppler navigation systems, altimeter. |

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<tr>
<th>Examination</th>
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<tr>
<td>Prerequisites</td>
<td>mathematics, physics, basics of electromagnetic theory and high frequency technique</td>
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<td>Lecturer</td>
<td>Plettemeier</td>
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<tr>
<th>12 02 30</th>
<th>Power Electronic Devices and Applications</th>
<th>oral</th>
<th>basics in power electronics</th>
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<td>EI</td>
<td>LEPE W 2 0 1</td>
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<td>Gülnder</td>
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<td>This objective of the course is to provide detailed knowledge of power semiconductor devices with respect to their applications. The course consists of lectures, tutorials and laboratories which focus on a sound education in the principles of: Power Diodes (Switching Characteristics, Breakdown Voltage Considerations, Schottky Diodes), BJT's (Physics of BJT Operation, Second Breakdown, SOA, Drivers, Snubbers), Power MOSFETs (I-V Characteristics, Physics of Device Operation, Switching Characteristics, Snubbers and Overcurrent Protection, Gate Drivers), IGBT's (I-V Characteristics, Physics of Device Operation, Latchup, Drivers and Snubbers), Field-controlled Thyristors, MCT's, Power IC's, and new semiconductor materials. The course will be supported by extensive use of simulations packages (PSPice, Simplorer).</td>
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<tr>
<th>Examination</th>
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<tr>
<td>Prerequisites</td>
<td>basics in power electronics</td>
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<tr>
<td>Lecturer</td>
<td>Gülnder</td>
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<tr>
<th>12 02 31</th>
<th>Actuators</th>
<th>oral</th>
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<td>EI</td>
<td>LEPE W 1 1 0</td>
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- Content is under construction.
### 12 02 32 DC-DC Converter

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<tr>
<th>Code</th>
<th>Title</th>
<th>Language</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>EI LEPE</td>
<td>DC-DC-Converter</td>
<td>German</td>
<td>4.5 cr</td>
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- Content is under construction.

### 12 02 33 Power Electronic Assemblies

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<th>Code</th>
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<th>Language</th>
<th>Credit Hours</th>
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<tr>
<td>EI LEPE</td>
<td>Power Electronic Assemblies</td>
<td>German</td>
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The course provides a comprehensive knowledge of the design of power electronic assemblies with high component density. Functional aspects of the module and assembly development are electrical, electromagnetic, thermal and mechanical characteristics and demands of high reliability. Recycling and environmental friendliness are gaining increasing importance. Power packaging, heat dissipation and thermal management technologies, reliability and the environmental friendly design are included. Guidelines for development of power electronic modules and assemblies, which fulfill the various requirements, are the emphasis.

### 12 02 34 Turbogenerators

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<th>Code</th>
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<th>Credit Hours</th>
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<tbody>
<tr>
<td>EI LEPE</td>
<td>Turbogenerators</td>
<td>German</td>
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- Content is under construction.
12 02 35    Relativistic Consideration of the Electromagnetic Field Theorie
Relativistische Aspekte der elektromagnetischen Feldtheorie

EI   LEPE    W    2 0 0          cr
In the course the electromagnetic field theorie is considered from a relativistic point of view. This leads to a simple and consistent formulation of electrodynamics. The following topics will be covered:
Fundamentals of the special theory of relativity; Lorentz-transformation; the Minkowski-space and its representation by means of Minkowski-diagramms; Transformation of the elektromagnetic field; Covariant formulation of Maxwells equations
examination: Oral          language: German
prerequisites: Electromagnetic Field Theorie I and II
lecturer: Binner

12 02 36    Magnetic Technology
Magnettechnik

EI   LEPE    S    2 1 0          4.5 cr
The lecture offers a survey of several aspects of the magnetic technology. Main topic is the application of recent rare-earth permanent magnets. The following topics will be covered:
Mathematical description of low-frequency magnetic fields; Methods of calculation; the FEM-Software ANSYS®; Physics of magnetization of ferromagnetic materials; Softmagnetic and hardmagnetic materials (Parameters and areas of application); Magnetic measurement methods; selected applications;
examination: oral          language: German
prerequisites: Principles of Electrical Engineering
lecturer: Gonschorek/Binner
Control of Continuous-Time Processes I
Steuerung kontinuierlicher Prozesse I

EI LCT S 3 2 0 7.5 cr
The course provides knowledge and skills for the analysis and design of continuous time linear single-loop control systems by treating mathematical methods for their representation, stability and parameter sensitivity, as well as controller design approaches. Topics covered include: aims of control theory, mathematical description of linear transfer elements in both time and frequency domain, description of the behaviour and analysis of linear simple loops, algebraic stability criteria (Bézout, Hermite, Routh-Hurwitz, Michailov-Leonhard-Cremer, Strecker-Nyquist, Charitonov), analysis of parameter sensitivity and sensitivity functions, and controller design (loop shaping, root locus methods and their generalizations, Youla parameterization of all stabilizing controllers).
Computational exercises concentrate on topics supporting the acquisition of capabilities and applicable knowledge and motivate deeper understanding through the solution of problems by MATLAB based simulations.

examination: written
language: German

prerequisites:

lecturer: Reinschke

Control of Continuous-Time Processes II
Steuerung kontinuierlicher Prozesse II

EI LCT S 2 2 0 6 cr
Mathematical methods for the representation of linear multi-variable (MIMO) control systems and controller design for such systems are treated. The following topics are covered: time and frequency domain description, state representations, controllability and observability and their consequences, controller design by pole assignment (via state or output feedback and state observers), pole-zero concepts for MIMO systems, design of decoupling and disturbance attenuating controllers, time and frequency domain description stability and design of sampled control systems, outlook on advanced topics like structural control theory (graph theoretic approach), optimal control (LQR design), nonlinear control theory, adaptive control theory, and robust control theory.
Computational exercises concentrate on topics supporting the acquisition of capabilities and applicable knowledge and motivate deepening independent solution of problems by MATLAB based simulations.

examination: written
language: German

prerequisites: Control of Continuous-Time Processes I

lecturer: Reinschke
12 03 03  Process Identification I
Prozessidentifikation I

EI   LCT  W  210  4.5 cr

The course provides an introduction to system identification, especially parameter estimation. Topics covered are: model structure selection, parametric models, static and dynamic models, linear regression and least-squares, computational aspects, and test signals (noise, pseudo random binary signals). The course contents comprises: solvability of systems of linear equations, matrix decompositions, singular values, Moore-Penrose inverse, discrete models (ARX, ARMAX, FIR filters), direct identification of continuous models using filters, estimation of physical parameters, examples.

examination: written
prerequisites: Control of Continuous-Time Processes I
lecturer: Röbenack

12 03 04  Nonlinear Control Systems
Nichtlineare Regelungssysteme

EI   LCT  W  211  4.5 cr

Students are led to understand the fundamental concepts, notions and methods of nonlinear control theory. The topics are the following: investigating nonlinear 2nd order systems in the phase plane, harmonic balance and describing functions, Lyapunov stability theory, absolute stability (circle and Popov criteria), design of nonlinear control systems, introduction to the differential geometric theory of nonlinear systems, outlook on recent developments in nonlinear control theory.

Computational exercises concentrate on topics supporting the acquisition of capabilities and applicable knowledge and motivate deeper understanding through the solution of problems by MATLAB based simulations.

examination: written
prerequisites: Control of Continuous-Time Processes I+II
lecturer: Reinschke

12 03 05  Linear Systems: A Module Theoretic Approach
Lineare Systeme: Ein modultheoretischer Zugang

EI   LCT  S  200  3 cr

The module theory of linear systems is treated. Systems are defined in a coordinate free manner as modules. With different choices of the ring considered different system classes are obtained: finite dimensional systems (time-varying or not, continuous or discrete), systems with delays, or systems with distributed parameters. The algebraic concepts required are defined, concepts from systems theory are introduced, and relations with other approaches are established. The course contents comprises: (required) algebraic structures, differential and discrete finite dimensional systems (in particular time-varying systems), systems with delays, controllability, observability, input-output and state representations, system decomposition, system inversion, trajectory planning and feedforward control, feedback tracking, examples.

examination: oral
prerequisites: Control of Continuous-Time Processes I+II
lecturer: Rudolph

63
### 12 03 06 Flatness Based Control of Nonlinear Systems

<table>
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<td>The course provides an introduction to the flatness concept and the design of feedforward and feedback tracking control for nonlinear flat systems. Several technological case studies are discussed, e.g. nonholonomic car, chemical reactors, induction motor, airplane, and gantry crane. Topics covered are: motivation of flatness based tracking control, definition of flat systems, notions of inputs and states, flatness based open-loop control (analysis of equilibria, trajectory planning, steering), flatness based closed-loop control (state feedback, exact linearization, stabilization), tracking observers, flat and non-flat systems (necessary conditions, series structures, defect, and orbital flatness), outlook to flatness based methods for infinite dimensional systems (systems with delays and systems with distributed parameters).</td>
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<td>examination: oral language: German</td>
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<td>prerequisites: Control of Continuous-Time Processes I</td>
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<td>lecturer: Rudolph</td>
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### 12 03 07 Analysis and Design of Multivariable Control Systems in the Frequency Domain

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<td>After a general introduction to multi-variable control problems the course covers the following topics: description of MIMO-plants in the frequency domain, transfer function matrices and singular value decomposition, analysis and synthesis of closed-loop MIMO-systems (structural properties, stability, integrity, robustness), H-infinity optimal design, MATLAB tools.</td>
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<td>prerequisites: Control of Continuous-Time Processes I</td>
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<td>lecturer: Wilfert</td>
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### 12 03 08 Process Identification II

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<td>The course provides an introduction to signal processing based on stochastical considerations. Basic topics on random variables and random vectors are recalled (e.g., distribution and density functions, transformation of random variables, expectation value, moments). The course contents comprises: random processes (especially stationary processes), estimation of mean value and variance, confidence intervals, hypothesis testing, auto and cross correlation function/sequence, Fourier and two-sided Laplace transformation, power spectrum functions, spectral estimation, periodogram method, linear systems, nonpara-metric models.</td>
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<td>examination: written language: German</td>
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<tr>
<td>prerequisites: Control of Continuous-Time Processes I</td>
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<tr>
<td>lecturer: Röbenack</td>
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12 03 09  Structural Control Theory  
Strukturelle Regelungstheorie

EI  LCT    S  2 0 0  3 cr
The course provides an introduction to large-scale systems. These systems are analysed using graph-theoretic methods, i.e., the control system is modelled by a suitably chosen graph representation. The system properties (such as structural controllability and observability) may be expressed by properties of the graph. The course contents comprises: representations of large-scale control systems (directed and bipartite graphs), topics from graph-theory (paths, cycles, matchings, decomposition of graphs), structural (i.e., generic) properties and their graph-theoretic characterizations, computational aspects, open-loop, closed-loop control, pole placement, examples.

examination: oral  language: German
prerequisites: Control of Continuous-Time Processes I
lecturer: Röbenack

12 03 10  Dependability of Technological Systems  
Zuverlässigkeit technischer Systeme

EI  LCT    W  2 0 0  3 cr
The course introduces the fundamental concepts, notions, and methods of dependability technology and their mathematical bases. It provides knowledge and skills for dependability assessment of complex automated systems. The following topics are covered: history and problems of dependability technology, role of reliability mathematics, probabilistic availability measures (for objects with and without renewal) and their statistic verification, system reliability (Boolean models, Markovian models, etc.), methods for improving reliability and safety (redundancy techniques, tolerance analysis, maintenance/inspection). Hints to dependability work in industrial environment are given.

examination: written  language: German
prerequisites: Process Identification I
lecturer: Reinschke

12 03 11  Optimal Control of Continuous Processes  
Optimale Steuerung kontinuierlicher Prozesse

EI  LCT    S  2 0 0  3 cr
The course provides an introduction into modern concepts and methods for optimal and model predictive control. Topics covered are: Optimal control with complete knowledge about the plant (finite horizon optimal control and LQR problem both in discrete and continuous time), controller design in systems with uncertainties (H-infinity optimal control, robust stability with unstructured uncertainties, robust performance by $\mu$-synthesis), model predictive control (control problem as optimization problem, numerical solution, stability, realization aspects).

examination: oral  language: German
prerequisites: Control of Continuous-Time Processes I+II
lecturer: Bartholomäus, Reinschke
Considering various technological examples so-called methods for the control of linear or nonlinear distributed parameter systems are treated, specifically the so-called flatness based approach as developed at the 'Institut für Regelungs- und Steuerungstheorie'. The systems discussed are described by partial differential equations, they are infinite dimensional. The control most often acts on the boundary. A particular subclass considered is the class of linear delay systems.

Topics covered are: examples of systems with spatially distributed parameter systems (including modeling aspects), problem of finite time transition between stationary regimes, linear hyperbolic systems modeled as systems with delays (wave equation, telegrapher’s equation), linear systems with distributed delays (heat exchanges, general telegrapher’s equation), linear parabolic systems (heat equation, tubular reactor equations, ...), linear beam equations (examples of flexible robot arms and piezo-electric benders), extensions to nonlinear hyperbolic, parabolic, and delay systems.

examination: oral
language: German
prerequisites: Control of Continuous-Time Processes I+II
lecturer: Rudolph
As a link between basic and main studies this course deals with the engineering principles of power engineering. The lecture starts with and voltage stresses of the equipment, followed by protection measures against electric shock. Further topics are three-phase systems, ac- machines, the drive system and principles of power electronics. The generation and distribution of electric power and the necessary elements are described.

- **Examination:** written
- **Language:** German
- **Prerequisites:** physics, mathematics, electrical engineering
- **Lecturer:** Schegner

The basic principals of power transmission and electrical propagation are explained. The main focuses of the lectures are on mathematical descriptions of polyphase circuits and transmission-line analysis.

The transformation of periodical three phase systems in symmetrical components (Fortescue transformation), $\alpha\beta0$ components (Clarke transformation), space phasor components and $dq0$ components (Park transformation) are illustrated.

Based on Maxwell's theory the propagation of transverse electromagnetic waves (TEM) is described. The time- and frequency-domain solution for this basic equation is deduced. In addition the time-domain solution of the telegraphers equation and graphical methods to estimate the wave propagation are illustrated.

- **Examination:** written
- **Language:** German
- **Prerequisites:** mathematics, principles of electrical engineering
- **Lecturer:** Schegner

The lecture deals with planning and design of switchgears. It considers the electrical power system and its components, like substations and consumer installations. Further topics are: Planning and construction of electrical power switchgears; Principle of selecting switching devices; Parameters and basic layout of switchgears; Design of switchgear panels; Construction of outdoor electrical installations and gas-insulated switchgears; Method of
12 04 04 Power System Protection and Control
Netzschatztechnik

EI  LEPHV  S  2 1 0  W  0 0 1  6 cr
The lecture gives a survey of protection relaying and control in electric power systems. The following topics are discussed in detail: Failure states and their transients; Requirements of selectivity, dependability and reaction time; Protective criteria and measuring components; Conventional, electronic and digital protection devices; Digital algorithms for fault impedance calculation; Protection of transmission lines, transformers and bus-bars; Information transfer with the digital substation control equipment; Electromagnetic compatibility (EMC) and software quality; Voltage and current transformers; Auxiliary power equipment; Failure display with the help of transient recorders; Control structures and stand-by philosophy; Interaction of control and protection equipment; Synchronization and switchgear interlocking; Information transfer and fibre optics.

examination: written  language: German
prerequisites: electrical power systems
lecturer: Schegner/Bauer

12 04 05 Computer-aided Design of Switchgear Stations
(Elektroanlagenprojektierung)

EI  LEPHV  W  1 2 0  4.5 cr
Selected problems of computer planning and design of switchgear stations are tackled in this course. The lecture deals with: Circuit and terminal diagrams for station equipment; Design and construction of switchgears; Designation of devices; Planning of low, medium and high voltage installations; Configuration schematics of switchgear layouts; CAD-systems for planning of substations; Design of auxiliaries and emergency power supplies.

examination: written  language: German
prerequisites: electrical power systems
lecturer: Schegner

12 04 06 Computation of Electric Power Networks
(Netzberechnung)

EI  LEPHV  W  2 2 0  6 cr
In addition to the method of symmetrical components there are also the diagonal- and Park components including in this lecture. Operation and iterative computation of long high-voltage transmission lines are discussed as well as the construction and topology of power networks. Calculation of current distribution with different methods (manual transfiguration, node impedance matrix method) in large power networks is explained. The lecture includes also the calculation of symmetrical and nonsymmetrical short-circuits in meshed power networks by manual and digital methods. The fundamentals of steady-state and transient stability are
The lecture gives a survey of states and processes in electrical power systems. The main topics are: Systems under normal and fault operating conditions; Steady and transient states, like temporary over-/undervoltages and overcurrents, resonant voltages and currents, lightning voltages; Process management, especially switching operations; Frequency, voltage and power controllers; Analysis of faults and blackouts; Calculation of power quality parameters; Insulation coordination for electrical equipments; Stochastic character of network processes. 5 practical exercises help to understand the lectures better.

---

**12 04 08   Applied Statistics for Electrical Engineers**
Angewandte Statistik für Elektrotechniker

EI   LEPHV  W  1 1 2   6 cr

Applicable methods of statistical assessment in the field of high voltage engineering are given, based on the fundamentals of mathematical statistics. The application of statistical methods to the design of high voltage insulations, the reliability assessment and the coordination of insulation are considered.

examination:   oral
prerequisites:   fundamentals of statistics
lecturer:       Großmann/Speck

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**12 04 09   Advanced Seminar on Power Supply**
Oberseminar Energieversorgung

EI   LEPHV  S  1 1 0   3 cr

- Content is under construction.

examination:   language: German
prerequisites:
lecturer:       Schegner
12 04 10  Efficient Energy Utilization
Rationelle Energieanwendung

EI  LEPHV  S  2 0 0  3 cr
The lecture deals with the efficient use of electrical energy in the fields of industry, trade, agriculture and household. Students will get the qualification to carry out analyses of processes in systems for transformation and transportation of electric energy as well as rating and selection of electrical equipment with regard to the economical use of electrical energy. Further topics are: Basic of power economics including raw material resources; Technologies of electrical power generation; Renewable energies; Process analysis of application of electrical energy; Transport of electrical energy including calculation of losses. An excursion to a modern energy conversion station is planned.

examination: written  language: German
prerequisites: electrical power systems
lecturer: Schegner

12 04 11  Calculation of reliability and certainty
Zuverlässigkeits- und Sicherheitsberechnung

EI  LEPHV  S  1 1 0  3 cr
- Content is under construction.

examination:  language: German
prerequisites:  
lecturer: Bauer

12 04 12  Lightning Protection
Blitzschutztechnik

EI  LEPHV  S  1 0 0  1.5 cr
The fundamentals, concepts and technical measures of protection against direct lightning strokes and electromagnetic effects of the lightning stroke are being taught based on the physical appearances, parameters and electromagnetic effects of lightning discharges. The students are being qualified to judge the necessity and effectiveness of lightning protection measures and to support the design of protection equipments.

examination: oral  language: German
prerequisites: fundamentals of electrical engineering and high voltage engineering
lecturer: Großmann/Engelmann

12 04 13  High Voltage Engineering
Hochspannungstechnik I

EI  LEPHV  W  2 1 0  S  0 0 2  7.5 cr
The physical and technical fundamentals of high voltage engineering are being conveyed. The lecture presents highvoltage generation ans measurement, high voltage electric fields, electric processes in gases, flashover phenomena of insulators and lightning as well as
conduction, polarisation and breakdown processes in liquids and in solid insulating materials.

examination: oral language: German
prerequisites: fundamentals of electrical engineering
lecturer: Großmann/Speck

12 04 14 High Voltage Engineering II
Hochspannungstechnik II
EI LEPHV S 2 1 0 W 0 0 1 6 cr

- Content is under construction.

examination: oral language: German
prerequisites: fundamentals of electrical engineering
lecturer: Engelmann/Löbl

12 04 15 High Current Engineering
Hochstromtechnik
EI LEPHV W 2 1 1 6 cr

This lecture conveys the physical and technical basics for design and development of high current devices concerning their current-carrying capacity. The relationships between the load for the conducting path due to operating and short-circuit currents and the resulting thermal and mechanical stresses will be taught.

The fundamentals of electrical contacts will be imparted. The students learn how to test high current devices.

examination: oral language: German
prerequisites: fundamentals of thermodynamics and mechanics
lecturer: Löbl

12 04 16 High Voltage Insulation Engineering
Hochspannungsisoliertechnik
EI LEPHV S 2 0 0 3 cr

The fundamentals of high voltage engineering are being applied to practical insulating problems. The lecture concerns the chemical and physical properties and the application of inorganic and polymer insulating materials, the stress, the design, the technology and the test methods of the insulating systems of cables, rotating machines, transformers and capacitors.

examination: oral language: German
prerequisites: high voltage engineering
lecturer: Großmann/Engelmann
12 04 17  High Voltage Testing and Measuring Techniques
Hochspannungs- Prüf- und Messtechnik

EI   LEPHV  W  2 0 1  4.5 cr
This lecture conveys knowledge of high voltage testing and measuring systems for direct, alternating and impulse voltages, the generation and measuring of impulse currents, the application of field probes, partial discharge measuring systems and measuring methods diagnosis of high voltage insulations. The response behaviour and the calibration of these measuring systems are being treated. The conveyed knowledge should enable the students to select and apply properly high voltage testing and measuring systems.

examination: oral
language: German
prerequisites: fundamentals of electrical engineering and high voltage engineering
lecturer: Großmann/Engelmann

12 04 18  High Voltage Apparatus
Hochspannungsgeräte

EI   LEPHV  S  2 0 1  4.5 cr
This lecture conveys relationships between the effects of electrical current in high voltage apparatus and the environment (ambient temperature, solar and sky radiation, windspeed, chemically aggressive atmosphere). The life time of the apparatus can be calculated based on physically determined limiting values. Methods for dimensioning of the conducting path are consolidated.

examination: oral
language: German
prerequisites: high current engineering
lecturer: Löbl

12 04 19  Substation and power system control
Leittechnik

EI   LEPHV  S  2 1 0  W  0 0 1  6 cr
The lecture gives a survey of substation and power system control. The following topics are discussed in detail:
- Requirements of dependability, safety, accuracy, reaction time and synchronous sampling measurement method of voltages and currents,
- operator interface and interface circuits of measurement, message and control,
- open substation communication in conformity with IEC 61850,
- diversity redundancy of conventional and digital control devices,
- logical and topological switchgear interlocking,
- circuit breaker and transformer monitoring,
- electromagnetic interference (EMI) and electromagnetic compatibility (EMC).
Laboratory practice: switchgear interlocking, substation operator interface, optical fibre in substations.

examination: oral
language: German
prerequisites: mathematics, physics, electrical power engineering
lecturer: Bauer
Energy markets are currently subject to significant restructuring processes. In particular, the electricity and natural gas sectors are transforming from monopoly to competitive structures, local to global markets, and from fossil based technologies to a larger share of renewable sources.

The lecture is structured in three parts:
1. The first part presents an overview of global energy markets (including oil, natural gas, coal, and electricity). Developments of the last decades, current and future challenges, and basic economic relations are introduced.
2. The second part takes up the issue of network management and modeling from an economic viewpoint. By combining technical characteristics of electricity grids and economic valuation methods the impact of different network related topics (e.g. congestion management, feed-in of renewable energy) are highlighted.
3. The last part closes with a basic introduction into managerial methods electrical engineers are likely to get into touch with in energy companies. These include trading of energy commodities and investment decisions.

examination: written exam and homework  
language: German

prerequisites: Elektroenergiesysteme
lecturer: v. Hirschhausen

The lecture gives a survey of electrical power systems. After an introduction in the method of symmetrical components and its application to the decoupling of three-phase systems the lectures deal with the construction, performance quantities, operation conditions and development trends of overhead transmission lines, cables, generators, transformers, reactors and capacitors as the main parts of an electrical power system. Load flow calculation includes radial and ringnetworks and their parallel and series compensation. The short-circuit calculation is concentrated on three-phase and single-phase faults in networks. The advantages and disadvantages of different earthing methods are discussed in detail. For better understanding a lot of numerical and practical exercises are part of the lecture.

examination: written  
language: German

prerequisites: physics, mathematics, electrical power engineering
lecturer: Schegner
12 05 01  Electronic Systems Design
Geräteentwicklung

EI LEED  S  2 1 0  4.5 cr
This course focuses on the design and development of electronic devices and systems. A main objective is to understand and to solve engineering tasks in this field. Emphasis is placed on the main aspects of the development and design process of electronic devices and systems, subject to various constraints (device protection, reliability, EMC, shielding, thermal dimensioning).

examination: written
language: German
prerequisites:
lecturer: Lienig

12 05 02  Design Engineering
Konstruktionstechnik

EI LEED  W  2 0 1  4.5 cr
This course provides students with the basic skills that enable them to use experimental results in the design of electromechanical devices and systems. The course describes the planning and construction phases of complex electromechanical systems. Some of the topics addressed in this lecture are: modelling of discrete elements such as logical, cybernetic, electrical, mechanical and thermal elements, inclusion of the measurements in the simulation experiments, reductive and deductive processes, computer aided design of electromechanical systems.

examination: oral/written
language: German
prerequisites: undergraduate core courses
lecturer: Kamusella

12 05 03  Physical Design and Physical Design Automation
Elektronische Gerätetechnik II, Rechnerunterstützter Baugruppenentwurf

EI LEED  S  2 1 0  4.5 cr
Major goal of this class is an introduction into physical/layout design of an electronic circuit and PCB, including application of CAD methodologies. All physical design steps (such as schematics, placement, routing) are considered and relevant constraints discussed in detail. Lab exercises include the generation of a circuit/PCB layout using a commercial CAD system.

examination: oral
language: German
prerequisites: undergraduate core courses
lecturer: Lienig
<table>
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<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Semester</th>
<th>Credits</th>
<th>Examination</th>
<th>Language</th>
<th>Prerequisites</th>
<th>Lecturer</th>
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<tbody>
<tr>
<td>12 05 04</td>
<td>Optical Systems</td>
<td>S 210</td>
<td>4.5 cr</td>
<td>oral</td>
<td>German</td>
<td>undergraduate core courses</td>
<td>Lakner</td>
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<td>Technische Optik</td>
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<td>12 05 05</td>
<td>Machine Elements</td>
<td>W 220 S010</td>
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<td>Konstruktionselemente</td>
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<td>12 05 07</td>
<td>3D-CAD</td>
<td>S 002</td>
<td>3.0 cr</td>
<td>oral/written</td>
<td>German</td>
<td>undergraduate core courses</td>
<td>Kamusella</td>
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<td></td>
<td>Konstruktion 3D-CAD</td>
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<td>12 05 08</td>
<td>Precision Device Engineering</td>
<td>W 210</td>
<td>4.5 cr</td>
<td>written</td>
<td>German</td>
<td>undergraduate core courses</td>
<td>Nagel</td>
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<td></td>
<td>Präzisionsgeräteotechnik</td>
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12 05 09  Product design potly. Development
   Produktentwicklung

EI   LEED  S  2 0 0  3 cr
This course focuses on the engineering and management tasks in product design. Emphasis is placed on the main aspects of the development process of a product in close relationship with the required methodological and management skills of an engineer.

examination: Oral/written  language: German
prerequisites: undergraduate core courses
lecturer: Schulze

12 05 10  Algorithms for VLSI Physical Design Automation
   Entwurfsautomatisierung

EI   LEED  W  2 1 0  4.5 cr
This course provides students with detailed knowledge in algorithms for VLSI physical design automation. Methods and algorithms for the individual design steps (from netlist to finished layout) of an electronic system are introduced. The software implementation of these methods and algorithms are considered to be the principles of the modern electronic design systems. The lecture covers the following topics: partitioning, placement, routing, compaction and verification.

examination: written  language: German
prerequisites: undergraduate core courses, Physical Design and Physical Design Automation
lecturer: Lienig

12 05 11  Precision Gear Technology
   Präzisionsgetriebe

EI   LEED  W  2 0 1  4.5 cr
This course focuses on the development of precision toothed wheel and toothed belt drives within the framework of electromechanical systems. Dimensioning and adoption of these drives according to different operating conditions are of interest as well. The required practical knowledge is obtained by visiting a practical course, by taking part in related scientific excursions and from lab work.

examination: written  language: German
prerequisites: undergraduate core courses
lecturer: Nagel

12 05 12  Finite Element Method
   Praktische Einführung in die Finite Elemente Methode

EI   LEED  S  0 2 0  or  S  0 2 0  3 cr
This practical course aims at providing students with the basic knowledge and skills needed for the simulation of spatial stress of electromechanical components. Modelling is carried out using the Finite element method (FEM) while taking into consideration the nonlinear material characteristics.
examination: oral/written
prerequisites: undergraduate core courses
lecturer: Kamusella

language: German
12 06 01  Project Electronics Technology  
Projekt Elektroniktechnologie

Team work to solve tasks in the field of:
- Design of electronic circuits
- Process optimisation
- PCB-production
- Testing
- SMD-assembly
- Quality management

All students of the study branch Electrical Engineering at the Department of Electrical Engineering and Information Technology have to take this course in the 3rd semester. The course brings basic knowledge about design and production of electronic devices to the students. It supports the team oriented practical work of the students because they have to form groups of six students to solve the problems. For many of them this practical work will be the only experience in designing and producing an electronic device in their working life, because they will work in the fields software development, information technology or power generation.

examination: certificate
language: German
prerequisites: Mechanical science, product design, materials science
lecturer: Wolter, Zerna

12 06 02  Packaging I  
Aufbau- und Verbindungstechnik I

Teaching of electronic materials, technology and techniques for manufacturing of electronic components and modules.

Content:
- function of packaging
- packaging for semiconductors devices
- packaging for modules
- technologies for thin- and thick film substrates
- techniques for printed circuit boards
- assembly of semiconductor devices
- surface mount technology

Practical training is included.

examination: written
language: German
prerequisites: Basic study
lecturer: Wolter
12 06 03  Electronics Packaging II  
Aufbau- und Verbindungstechnik II

EI  EPL  S  2 0 0  W  0 0 2  6 cr

Teaching of techniques for advanced packaging, as bumping of Area-Array-Components, conductive adhesives, surface treatment of contact materials as well as integrated optical waveguides.

Content:
- Requirements of electronic packaging
- packaging for Area-Array- Components
- adhesives in electronics
- surface treatment
- integration of wave guides in PCB

Practical training is included.

examination: written  
language: German

prerequisites: Basic study and Packaging I

lecturer: Wolter / Wiese

12 06 04  Precision Drives  
Präzisionsantriebe

EI  EPL  S  2 1 0  4.5 cr

Lectures and exercises - contents:
- Basics about electric-mechanical drives with low power and about micro technical drives
- Physical and technical properties of actors
- Structure of drives and drive systems
- Magnetic circle
- Permanent excited DC-motors
- Stepper motors
- Piezoelectric positioning drives

examination: written  
language: German

prerequisites: constructional elements, design engineering, techniques of precision devices

lecturer: Uhlemann

12 06 05  Quality Management  
Qualitätssicherung

EI  EPL  S  2 1 0  4.5 cr

Lectures and exercises - contents:
- Description of quality parameters (discrete and continuous parameters and their distributions)
- Detection and computation of quality data
- Statistical tests of parameters
- Quality control cards and acceptance sampling plans
- Reliability tests
- Interaction of parameters

examination: written  
language: German

prerequisites: mathematics

lecturer: Wolter, Wohlrabe
12 06 06 Manufacturing Systems of Electronics
Fertigungssysteme der Elektronik

EI  EPL  S  2 1 1  6 cr

The lectures impart basic principles for evaluation, control and scheduling of manufacturing systems, with the focus on the time flow of the processes. The problems and solutions are predominantly exemplified by electronics and semiconductor production. Not only mathematical basics but – according to their increasing importance – also the discrete event simulation (DES) method as well as modern heuristic optimization algorithms are addressed. In the exercises and practical courses mathematical skills and experiences of application of DES systems are imparted.

examination: written  
language: German
prerequisites: mathematics, intermediate examination
lecturer: Weigert

12 06 07 Hybrid Technology
Hybridtechnik

EI  EPL  W  2 0 2  6 cr

Teaching of packaging techniques of hybrid micro systems and procedures for the production of thin-film and thick-film substrates as well as mounting techniques for thick-film hybrid modules.

Lessons:
- introduction to the hybrid technology
- substrates for the hybrid technology
- thin-film and thick-film technology
- rheology of the screen printing
- thermal processes
- single- and multilayer technology
- post office structuring
- designing principles and examination

Practical training:
- Printing and burning
- Resistance alignment
- Chip and wire bonding
- SMD assembly
- Function test and housing

examination: written  
language: German
prerequisites: Basic study
lecturer: Wolter/Rebenklau

12 06 08 Laser Technology
Lasertechnik

EI  EPL  W  2 0 1  4.5 cr

Teaching of laser principle and of the different kinds of laser equipment and their areas of application in laser machining and laser measuring for precision and micro technology.

Content:
- physical fundamentals of the laser including characteristics of laser radiation
- laser types, beam guidance
- material processing with laser radiation
• laser measuring technique

Practical course:
• laser basis for applications in the electronics technology
• laser process of ceramics by CO2-Laser
• laser process of metal foils by Nd-YAG-laser
• laser triangulation and interferometry

examination: written language: German
prerequisites: Basic study
lecturer: Wolter

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### 12 06 09 Statistic Methods for Process optimization

Statistische Methoden der Verfahrensoptimierung

**EI EPL W 2 1 0** 4.5 cr

Teaching of modern statistic methods of the process optimization.

**Content:**
• Regression analyses
• Analysis of variance
• Statistic experimental design (DoE Design of experiments)
• Evaluation of measuring systems
• Examples from electronics manufacturing

examination: written language: German
prerequisites: Basic study, Quality assurance
lecturer: Wolter / Wohlrabe

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### 12 06 10 Reliability of Electronics Modules

Zuverlässigkeit elektronischer Baugruppen

**EI EPL W 2 0 0** 3 cr

- design for reliability and testing
- requirements to components, printed circuit boards and additional materials
- first pass yield
- methods for testing of Board Level Reliability
- packaging demands of high integrated component
- damage mechanism of modules and verification
- excursion through a high tech company

examination: oral language: German
prerequisites: Basic study
lecturer: Albrecht

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### 12 06 11 Postgraduate Class Electronics Packaging

Oberseminar Aufbau- und Verbindungstechnik

**EI EPL W 0 2 0 S 0 2 0** 6 cr

Lectures, reports and seminars in the area of the modern packaging technology in electronics:
• lectures about the results of research and development of students and young scientists
• proceeding
• seminars to new developments and results on the subject
12 06 12 Testing / Visual Inspection  
Prüftechnik / Visuelle Inspektion

EI  EPL  S  2 0 1  4.5 cr
Lectures and practice work - contents:
- automatically image processing in electronics production
- methods of automatically image processing
- 3D data acquisition
- laser inspection, ultrasonic inspection and X-ray inspection
- Picture segmenting, picture pre-processing and characteristic extraction and classification

examination: Written  
language: German
prerequisites: Basic study
lecturer: Wolter / Bieberle

12 06 13 Electrical Security of Medical Devices  
Elektrische Sicherheit medizinischer Geräte

EI  EPL  S  1 0 1  3 cr
Lectures and practical course - contents:
- important aspects of European and German medical device directive
- electrical supply medically used buildings
- rules for safety class system of electric medical devices
- limit values of continuously flowing leakage current
- destroying and non destructive equipment inspection
- methods of measurement
- re-run of safety tests
- test algorithms
Practical training is included

examination: written or oral  
language: German
prerequisites: Basic study, biomedical engineering, circuit engineering, measuring technique
lecturer: Uhlemann

12 06 14 Biomaterials and Materials for Devices  
Biomaterialien und Gerätewerkstoffe

EI  EPL  S  2 1 0  4.5 cr
Lectures and exercises - contents:
- Definition and classification of biomaterials
- Biocompatibility
- Mechanical, physical and chemical properties of materials, change of properties
- Metallic biomaterials and alloys, especially high alloyed steel
- Glasses, ceramics and glass-ceramics as biomaterials and composites
- Carbon materials and carbon composites
- High polymeric materials, especially in contact with blood
- Procedure to change properties of materials and to sterilize
Inspection procedures for boundary surfaces with a view to enthalpy and zyto compatibility and haemo compatibility

examination: written language: German
prerequisites: Basic study, biomedical engineering
lecturer: Uhlemann

12 06 15 Practical Course Precision Engineering
Part C: Production of electronical devices
Praktikum Feinwerktechnik

EI  EPL  W  0 0 1          S  0 0 2          4.5 cr

Practical Course Precision Engineering Part C gets the students knowledge about the principles of manufacturing in electronics industries.
Experiments in to the 7th and 8th semester:
• C1 - Machine capability
• C2 - Inspection with Ultra Sonic Microscope
• C3 - X-ray inspection in electronics and micro techniques
• C4 - Laser welding in electronics and micro techniques
• C5 - Optimization of manufacturing processes
• C6 - Device safety

examination: certificate language: German
prerequisites: Basic study, measurement, precision engineering, precision drives, optics, packaging
lecturer: Wolter

12 06 16 Introduction in micro- and nano non-destructive inspection
Einführung in die Mikro- und Nano-Zerstörungsfreie Prüfung

EI  EPL  W  2 0 1          4.5 cr

Lectures and practical laboratory training - contents:
• Introduction
• Materials properties on the "nano"-scale
• Scanning probe techniques (imaging)
• X-ray and particle techniques
• Acoustic methods
• Magnetic techniques
• Optical characterization of surfaces and layers
• Mechanical characterization of surfaces and layers

examination: oral language: German/English
prerequisites: Basic study
lecturer: Meyendorf

12 06 17 Production Engineering
Fertigungstechnik

EI  EPL  W  2 0 1          4.5 cr

Lectures and exercises - contents:
• Process technology of electronics
• Mounting processes
• Design of processes and optimization of processes
### 12 06 18 Project Precision Engineering

**Project Feinwerktechnik**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
<th>Prerequisites</th>
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<tbody>
<tr>
<td>EI EPL</td>
<td><strong>W 0 1 0</strong></td>
<td>1.5 cr</td>
<td>Team work of two or three students to solve tasks in the field of current research activities of our Labs or cooperated companies. These problems refer to the design methods and techniques commonly used in the field of precision engineering.</td>
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<tr>
<td>examination:</td>
<td>Oral and written</td>
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<td>language: German</td>
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<tr>
<td>prerequisites:</td>
<td>Measurement, precision engineering, precision drives, optics, packaging</td>
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<td>lecturer: Wolter</td>
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### 12 06 19 Special Chapters of Packaging

**Spezielle Kapitel der Aufbau- und Verbindungstechnik**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
<th>Prerequisites</th>
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<tbody>
<tr>
<td>EI EPL</td>
<td><strong>W 2 0 0</strong></td>
<td>3 cr</td>
<td>Lectures and exercises - contents:</td>
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<td></td>
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<td></td>
<td>• Plasma techniques for modification of surfaces</td>
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<td>• Adhesion</td>
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<td>• Modern aspects and trends in Packaging</td>
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<td>• Flexible Printed Circuit Boards</td>
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<tr>
<td>examination:</td>
<td>Oral</td>
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<td>language: German</td>
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<tr>
<td>prerequisites:</td>
<td>Basic study, Packaging I and II</td>
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<td>lecturer: Wolter / Detert, Herzog, Paproth, Zerna</td>
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### 12 06 20 Computer tomography in electronics technology and medicine

**Computertomographie in der Elektronik-Technologie und Medizin**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>EI EPL</td>
<td><strong>S 2 0 0</strong></td>
<td>3 cr</td>
<td>Selected computer tomographic measuring procedures and their mathematical-physical as well as instrumentation bases are treated</td>
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<td>1. Mathematical bases of the CT</td>
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<td>• Theory of the picture reconstruction from projections</td>
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<td>• Analytic and algebraic reconstruction procedures</td>
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<td>• Cones beam CT</td>
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<td>• Nonlinear picture reconstruction</td>
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<td>• Limited data problems</td>
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<td>2. CT procedures</td>
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<td>• Roentgen CT</td>
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<td>• Gamma radiation CT</td>
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<td>• SPECT and PET</td>
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<td>• Electron beam CT</td>
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<td>• Electrical impedance, conductivity and capacity tomography</td>
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<td>• Optical tomography</td>
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<td>• Scattered light tomography</td>
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<td>• Magnet resonance tomography</td>
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</tbody>
</table>

84
The lectures impart basics of the discrete event simulation (DES) method and of modelling of manufacturing or general logistic systems. The main focus is the application of DES systems for simulation based scheduling of electronics and semiconductor manufacturing systems. In the practical exercises the simulation tool simcron MODELLER is exclusively used. Its special objects and components, the data interface and its optimization features are described in detail.

examination: written/oral
prerequisites: basics of applied informatics
lecturer: Weigert
12 07 01  Biomedical Engineering  
Biomedizinische Technik

EI  LBME  W  2 1 0  4.5 cr
The course is aimed to give a systematic overview of electric and electronic devices for diagnosis and therapy in medicine. The student will be introduced to relevant aspects of design and operation of biomedical systems as electromyography, electrostimulation, high frequency electrotherapy including high frequency surgery and electronic cardiac pacemakers.

examination: written, 3 hours  
language: German  
prerequisites: intermediate diploma  
lecturer: Poll

12 07 02  Medical Terminology for Biomedical Engineers  
Medizinische Terminologie für Biomedizintechniker

EI  LBME  S  1 0 0  1.5 cr
The aim of the course is to impart basic knowledge of linguistics in the medical field for students of electrical engineering, informatics, physics and economics with biomedical engineering background. Medical terminology is trained on the basis of lectures about biomedical equipment, signal and image processing and presentation. Subject matter are the development of medical terminology, the influences of modern foreign languages, synonymy, eponymy, metonymy, orthography, and abbreviations; phonetics, grammar, terms of position and direction, word formation, numerals, colours and medical disciplines. By means of scientific publications and medical reports, practical problems are to be discussed. Students get training in using medical terminology also with the help of e-learning software. Examples were used from the fields of heart, cardiovascular and respiratory system, kidney, monitoring, imaging, pacing and mechanical ventilation therapy.

examination: written  
language: German  
prerequisites:  
lecturer: Barth / Morgenstern

12 07 03  Application of ionizing radiation in medicine  
Strahlenanwendungen in der Medizin

EI  LBME  W  2 0 0  3 cr

Target group: students of biomedical engineering, physics, medicine
12 07 04  Technologically-significant Life Processes
Technikrelevante Lebensprozesse und -strukturen

EI   LBME  S  3 1 1   7.5 cr

This course introduces anatomical, physiological and pathological facts relevant to
development, design and application of biomedical systems. Starting from the functional
characteristics of the human organism a description of subsystems such as respiratory
system, blood circulation, metabolism as well as processes of regulation and detoxification
is given. Specific features of the interaction between organism and medical equipment
including relevant medical standard specifications will be discussed.

A practical course at a hospital will give the opportunity to obtain practical knowledge about
the application of medical equipment in a clinical environment. In particular the application
of specific medical equipment will be shown in several units including perinatology,
radiology and intensive care unit.

examination: oral, 30 minutes  
prerequisites: Biomedical Engineering  
lecturer: Poll

12 07 05  Signal processing within biomedical devices
Signaltechnik in biomedizinischen Geräten

EI   LBME  W  2 1 0 + 0 0 2  S  1 0 0   6 cr + 3 cr

The course will lead the student into essential fields of the application of informatics in
biomedical systems. Main area is the systematic presentation of the digital processing of
biologically generated signals and the integration of micro-controllers in biomedical equip-
ment. In detail the lectures will comprise such topics as algorithmic formulation of medical
problems, relevant signals in medicine, characteristics of electric biomedical signals, met-
ods of biosignal processing and the application of micro-controllers.

Students of Electrical Engineering may add a practical training course at the technical de-
partment of the university clinicum (tasks of measuring, programming, service of medical
devices). In this case they will get three additional credit points.

examination: oral  
prerequisites: Technologically-significant Life Processes  
lecturer: Poll

12 07 06  Medical Equipment for Diagnostics
Diagnostische Gerätetechnik

EI   LBME  W  2 0 0  S  1 1 0 + 0 0 1   6 cr + 1.5 cr

The course gives the students basic knowledge about functions and technical realization of
diagnostic devices in medicine. A general treatment of measurement of biologically
generated signals is presented with the aim of an optimal and minimal invasive adaptation
of measurement equipment to individual patient conditions. Algorithms for evaluation and
quality assessment are discussed. In winter courses topics are image acquisition,
processing and presentation in real medical imaging systems, such as CT, MRI,
ultrasonics, SPECT and PET, and multimodal data fusion algorithms; in summer semester sensing of biosignals, signal acquisition and processing, and monitoring.
Additionally the student of electrical engineering / biomedical engineering will have a chance to apply his knowledge in practical laboratory exercises with biomedical equipment such as medical imaging and image processing (principles, X-ray equipment, CT, SPECT, microscopy, ultrasonics), signal acquisition and processing (algorithms, non-invasive measuring of blood pressure, electrocardiography).

examination: written
prerequisites: Technologically-significant Life Processes
lecturer: Morgenstern / Poll

12 07 07 Medical Equipment for Therapy
Therapeutische Gerätetechnik

EI LBME W 2 0 0 S 1 1 0 + 0 0 1 6 cr + 1.5 cr
The basic principles of therapeutical engineering are presented. A systematic overview over the technical equipment for therapeutic treatment of patients is given classifying the applied methods by the underlying physical principles.
In the winter course the following methods and devices are introduced: anesthesia, respiratory therapy, endoscopy, minimal invasive surgery, ultrasonic radiation therapy, therapy with ionising radiation and lithotripsy. The summer course deals with transplantation, biocompatibility, cell therapy, artificial kidney, artificial beta cells, assist systems for heartfunction and metabolism and with infusion therapy.
A practical training course is added for students of electrical engineering only (additional 1.5 credit points).

examination: written
prerequisites: Biomedical Engineering, Technologically-significant Life Processes
lecturer: Poll

12 07 08 Medical Image Processing and Visualization
Medizinische Bildverarbeitung und Visualisierung

EI LBME S 1 0 1 3 cr
Representative diagnostic imaging methods are introduced, and image processing and improvement methods are discussed. Steps of medical imaging from data acquisition to visualization are presented: imaging modalities, image characteristics, reconstruction algorithms, standards for image data format, several volume data models, interpolation, rendering, segmentation, classification, transformation, data compression. Methods and devices for 3D visualization are demonstrated. Image processing software tool (based on Matlab, Mathworks Inc.) enables the students to simulate image processing algorithms in biomedical engineering research field with real patient data. Practical application can be trained with the help of an optical computer tomography work place and a 3D medical imaging work place with autostereoscopic display technique, assisted by e-learning software.

examination: written
prerequisites: Medical Equipment for Diagnostics
lecturer: Morgenstern / F. Uhlemann
Interactions between biological objects and technical equipment may be described by models. These models can be an effective tool in biomedical engineering, when applied selectively – with a clear idea of destination, definition, parameter selection, model validation and verification of the simulation system. Steps of model generation, variability of models and handling aspects are discussed for various application fields. Computer simulations show model implementation in education and research systems.

History of modelling and model application in respiratory mechanics and mechanical ventilation field, mathematical model background and user interface configuration in various biomedical engineering areas are shown by example. Design and handling of models are practically trained with Matlab, Mathworks Inc., and toolboxes. Quality assessment of modelling and simulation results is discussed.

**examination:** written

**language:** German

**prerequisites:** basics of Systems Theory, Technologically-significant Life Processes

**lecturer:** Morgenstern

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This course gives the students basic knowledge about the protection of industrial property in a form processed for engineers. All steps from the idea up to a patent are discussed. The following points are discussed in detail: prerequisites for patents, all methods of safeguarding of protection rights, publishing without a prejudicial as to novelty effect. The student shall be enabled to the scientific use of patent literature and relevant databases.

**examination:** oral

**language:** German

**prerequisites:** -

**lecturer:** Adler / Kluge
### 12 08 01 Basic Electrical Engineering
(Grundlagen der Elektrotechnik)

<table>
<thead>
<tr>
<th>EI LCS</th>
<th>W</th>
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<th>6 Cr</th>
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</table>

- Basic Variables (Electrical Charge, Electrical Current, Voltage, Energy and Power)
- Resistive One-Ports (Definition, Sources, Linear One-Ports, Circuits with One-Ports)
- Active and Passive One-Ports (Power consumption and delivery, Equivalent circuits)
- Network Theorems (Superposition, Equivalent circuits, Thevenin Theorem), Controlled Sources
- Network Analysis (Node Analysis, Mesh Analysis)

The exercises provide training of practical skills in modelling, analysis and design of DC-Circuits.

- examination: written
- language: German
- prerequisites: Mathematics, physics (college level)
- lecturers: Schwarz, Merker, Mögel

### 12 08 02 Electric and Magnetic Fields
(Elektrische und magnetische Felder)

<table>
<thead>
<tr>
<th>EI LCS</th>
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<th>9 cr</th>
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</thead>
</table>

- Introduction (Fields, Coulombs Law, Field Strength, Potential)
- Electric Current Field (Current Density, Field Strength, Elementary Fields, Power dissipation, Resistance, Conductance)
- Electrostatic Field (Displacement Flux, Field Strength, Polarization, Capacity, Elementary Fields, Displacement Current, Capacitor, Energy, Force Actions)

The exercises provide training of practical skills in the elementary computation of electric and magnetic fields and the analysis of field-based devices.

- examination: written
- language: German
- prerequisites: Basic Electrical Engineering and Mathematics (1st Semester)
- Lecturer: Merker
12 08 03 Dynamical Electrical Networks
(Dynamische Netzwerke)

EI LCS W 2 2 1 S 0 0 2 10.5 cr

Introduction (Dynamical Networks, Network Equations)
AC-Analysis of RLCM-Networks (Complex Network Analysis, Impedance, Admittance)
AC Power (Effective, Reactive and Apparent Power, Complex Power, Impedance
Matching, Passive Device Models)
Frequency Response (Nyquist Plots, Bode Plots)
Resonant Circuits (Series and parallel Resonance Circuits, Characteristics, Frequency
response)
Electrical Two-Ports (Voltage-Current-Relations, Parameters, Equivalent Circuits)
Transformers (Transformer Equations, Equivalent Circuits, Power Transfer, Frequency
Response)
Periodic Excitation (Periodic Signals, Characteristics, Fourier Series, Analysis of Networks
with periodic excitation)
Transient Network Behavior (Network ODEs, Continuity Conditions, Transient Network
Analysis)
The exercises provide training of practical skills in modelling, analysis and design of AC
and switching Circuits.
The Laboratory exercises introduce to practical measurements and analysis of electrical
networks and systems. They cover the content of Basic Electrical Engineering, Electric
and magnetic fields and Dynamical Networks.

examination: written
language: German
prerequisites: Mathematics (1rst, 2nd and 3d Semester), Basic Electrical Engineering,
Electric and magnetic Fields
lecturers: Schwarz, Merker, Mögel

12 08 04 Microelectronics
(Mikroelektronik)

EI LCS S 2 1 0 4.5 cr

Aim of the course is providing of specialized knowledge of structure, functionality and
electric characteristics of both the pn-diode and the transistor (biplar and MOS), whereas
realistic structures are in focus.
The topics of the course are:
- Introduction
- Examples of basic circuits
- Extended physical basics (for comprehension of real integrated components)
- pn-junction (explicit calculations, applications)
- Junction-FET
- Bipolar transistors (enhanced theory), - MOS-transistor (enhanced theory)
- CMOS-technology (composition, applications
- Optoelectronic components
- Overview of manufacturing processes

examination: written
language: German
prerequisites: Courses in Electrical Engineering, Physics, Mathematics I - III
lecturer: Schröter
### Electronic Devices

**Elektronische Bauelemente**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Type</th>
<th>Credits</th>
<th>Requirements</th>
<th>Examination</th>
<th>Language</th>
<th>Lecturer</th>
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</thead>
<tbody>
<tr>
<td>EI LCS W 2 1 0</td>
<td>Electronic Devices</td>
<td>4.5 cr</td>
<td>The course deals with basic knowledge of functionality and electrical properties of the most important basic structures of semiconductor components. The main topics of the course are: - Introduction, - principles of physics, - the pn-junction, - pn-diode, - bipolar transistor (ideal structure), - MIS-structure, MOS-transistor (ideal structure).</td>
<td>written</td>
<td>German</td>
<td>Courses in Electrical Engineering, Physics, Mathematics of first year</td>
<td>Schröter</td>
</tr>
</tbody>
</table>

### Measurement techniques

**Messtechnik**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Type</th>
<th>Credits</th>
<th>Requirements</th>
<th>Examination</th>
<th>Language</th>
<th>Lecturer</th>
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<tbody>
<tr>
<td>EI LCS S 2 1 0</td>
<td>Measurement techniques</td>
<td>4.5 cr</td>
<td>This course introduces the fundamentals of generic and in particular electronic measuring systems. The following topics will be covered: fundamental principles, terms and definitions (e.g. SI-units, measuring error and measurement uncertainty), recapitulation of basic statistics, error propagation, information content (Shannon, Fisher), noise (shot noise, thermal noise, quantization noise, SNR), limits of measurability (Heisenberg, Cramer-Rao-bound), analog electrical metrology (measurement of current, voltage and power, bridge circuits), measuring automation (computer-aided measurement processes, interfaces, virtual instruments, eigen-calibration), discussion of selected resistive, inductive, capacitive, piezoelectric, ultrasonic and optical measurement techniques for measuring time-of-flight, position, distance, velocity, rotation rate, flow rate, pressure, mechanical load, expansion and temperature.</td>
<td>written</td>
<td>German</td>
<td>intermediate examination or Bachelor degree in electrical engineering or mechatronics</td>
<td>Czarske</td>
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### Electronic Circuits

**Schaltungstechnik**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Type</th>
<th>Credits</th>
<th>Requirements</th>
<th>Examination</th>
<th>Language</th>
<th>Lecturer</th>
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</table>
12 08 08  Analogue Electronic Circuits  
(Analoge Schaltungstechnik)  

EI  LCS  W  3 2 0  W  0 0 1  9 cr  
This course provides basic knowledge for the design of analog circuits for an integrated realisation. The starting point is an overview about the properties of integrated devices and integration-specific restrictions and possibilities for circuit design. The main interest is given to the design of basic functional blocks and various types of amplifiers. For completion, methods for macromodelling and automatic circuit design are treated. Knowledge provided by the course is applied to an exemplary sensor-circuit design.  
examination:  written, 120 min  
language:  German  
prerequisites:  mathematics, electrical engineering I, II, III, electronic devices  
lecturer:  Schwarz  

12 08 09  Digital Electronic Circuits  
(Digitale Schaltungstechnik)  

EI  LCS  S  3 2 0  W  0 0 2  9 cr  
This course gives an introduction to analysis, dimensioning and modelling of digital circuits. Special emphasis is put on dimensioning of NMOS-, CMOS-, TTL- and ECL-circuits, basic logical elements, and complex units of modern VLSI-processors. In exercises students practise development and dimensioning of complex logic circuits, dynamic modelling and analysis of digital VLSI-circuits.  
examination:  written, 120 min  
language:  German  
prerequisites:  mathematics, electrical engineering I, II, III, electronic devices  
lecturer:  Schüffny  

12 08 10  Semiconductur electronics  
Halbleiterelektronik  

EI  LCS  W  2 1 0  4.5 cr  
Aim of the course is to provide knowledge of composition, mode of action, and design of components and structures for integrated circuits. The main topics of the course are  
- Introduction and overview,  
- Principles of physics as:  
  charge carrier transportation, material equations, semiconductor equations  
- Technology Computer-Aided Design (TCAD):  
  process simulation, component simulation, circuit simulation, numeric solutions  
- Additional effects in integrated components and circuits:  
  spread electric effects in most integrated circuits, electrothermic effects, effects with high frequencies, effects in MOS transistors with short and narrow channels  
examination:  written  
language:  German  
prerequisites:  Courses of base study  
lecturer:  Schröter
This course provides knowledge to design analogue and digital integrated circuits with modern CAD-tools. In particular, methods of integrated circuit design at various levels (system, behaviour, RT, logic, electrical and layout) are imparted. In exercises the students work on development of an algorithmic processor using the tools CADENCE, VERILOG-XL, and HSPICE on SUN-workstations.

examination: written language: German
prerequisites: mathematics, electrical engineering I, II, III, electronic devices
lecturer: Schüffny

This course provides methods for the design of complex VLSI processors. In particular the following fields are addressed:
- Design process, design layers, design methods, top-down design, hardware description languages (VHDL, IEEE,1076, Verilog-XL), RT-description, logic and layout
- Synthesis of processors, modelling of processors
- Specification, verification and architectures of processors Examples: CISC, RISC, DSP and controllers.

examination: written language: German
prerequisites: mathematics, electrical engineering I, II, III
lecturer: Schüffny

The course deals with some advanced problems in analog circuit design.
Device Modelling, Current Mirrors, Voltage References, Current Sources, Translinear Circuits, Nonlinear Properties, Transconductance Amplifiers, Transimpedance Amplifiers, Temperature and Tolerance Effects, Noise Analysis, Multipliers and Mixers, Switched Capacitor and Switched Current Circuits, Oscillators.

examination: written exam language: German
prerequisites: Mathematics, Fundamentals of Electrical Engineering, Electronic Devices, Electronic Circuits
lecturer: Jörges
12 08 14  Integrated RF Circuits
Integrierte Hochfrequenzschaltungen

EI  LCS  S  210  3 cr

- Content is under construction.

examination:  language:  German
prerequisites:  lecturer:  Ellinger

12 08 15  Nonlinear Circuits
Nichtlineare Schaltungen

EI  LCS  S  200  3 cr
Nonlinearities are mainly caused by active devices and can produce parasitic phenomena as signal distortions but can also be used to generate useful effects in signal generation and processing.
This course treats electronic circuits from a modern nonlinear systems viewpoint. Based on an introduction of the main principles of modern nonlinear dynamics theory typical effects of nonlinearities in electronic circuits are analysed and discussed. Standard differential equations of nonlinear electronic engineering such as the Duffing and the Van der Pol equation are derived and quantitatively and qualitatively solved. Special emphasis is directed to chaotic behaviour, its occurrence in electronic circuits and possibilities of practical applications. Global characteristics of nonlinear systems such as Lyapunov exponent and attractor dimensions and corresponding signal properties are treated.
This course provides an overview of most modern theoretical viewpoints and analysis methods used in nonlinear circuits and systems and introduces prospective practical applications.

examination:  written  language:  German
prerequisites:  analogue circuits, systems theory  lecturer:  Schwarz

12 08 16  Advanced Seminar VLSI Circuits and Systems
Oberseminar VLSI-Schaltungen und Systeme

EI  LCS  S  030  6 cr
A series of lectures given by prospective participants provides knowledge of research and development activities in selected research projects and gives an introduction to interdisciplinary project work.

examination:  oral  language:  German
prerequisites:  mathematics, electrical engineering, analog and digital circuit design  lecturer:  Schüffny
### Analogue Circuits II

**Schaltungen der Informationstechnik**

**EI LCS**  S  **200**  **3 cr**

Analogue circuit techniques have developed in the last decades very rapidly. This course continues the topics provided in the fundamentals of electronic circuits and contains modern aspects of analogue circuit design and analysis. Latest developments in current and voltage processing techniques such as transconductance and transimpedance amplifiers and current conveyors are treated as well as switched capacitor and switched current techniques. Switched circuits provide high efficiency power supply circuits, the fundamentals and practical application examples of which are presented in the lectures. Special emphasis is put to a thorough and fundamental analysis of oscillators and switching circuits from a viewpoint of modern nonlinear dynamic systems theory.

- **examination:** written
- **language:** German
- **prerequisites:** Analogue Electronic Circuits, Systems Theory
- **lecturer:** Schwarz/Krupar

### Logic Simulation and Test

**Logiksimulation und Test**

**EI LCS**  W  **201**  **4.5 cr**

The course gives an introduction to the role of and methods for logic simulation and testing applied to the design and manufacture of electronic circuits. The underlying principles of the techniques and algorithms for logic simulation, fault simulation, and test pattern generation for digital circuits are presented. Problems in modelling faults occurring during design steps and production are discussed. Several methods concerning design for testability are explained. As related topics, formal verification based on BDDs ('binary decision diagrams') and analogue testing are outlined. The practical exercises on workstations deal with VHDL simulation using a commercial simulator.

- **examination:** written
- **language:** German
- **prerequisites:** basic knowledge on digital circuits and switching theory
- **lecturer:** Straube

### Circuit Modelling and Simulation

**Schaltungsmodellierung und -simulation**

**EI LCS**  W  **200**  **3 cr**

An introduction into the work with the circuit simulator PSpice is given based on the netlist description of circuits and schematic entry (PSpice Design Center for WINDOWS). The knowledge provided by this introduction is increased by supervised practical exercises on personal computers including component modelling, subcircuit definition and different analysis modes (DC, AC, transient, Fourier and temperature sweep).

- **examination:** assigned paper
- **language:** German
- **prerequisites:** electronics
- **lecturer:** Schwarz/Müller
### 12 08 20  VLSI Architectures and System Simulation

**VLSI-Architekturen und Systemsimulation**

<table>
<thead>
<tr>
<th>EI</th>
<th>LCS</th>
<th>Term</th>
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<td>W</td>
<td>222</td>
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This course introduces the design of VLSI architectures for selected applications of digital signal processing (e.g. image and speech processing). In particular the following fields are addressed:

- Specification of complex digital systems
- Hardware Description Languages (VHDL, SystemC)
- VHDL syntax and language elements
- VHDL synthesis and modelling strategies
- Testbench generation and system simulation
- FPGA based rapid prototyping

**Examination:** oral

**Language:** German

**Prerequisites:** mathematics, electrical engineering I, II, III, digital circuit design

**Lecturer:** Schüffny

### 12 08 21  Industrial ASICs

**Industrielle ASICs**

<table>
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<th>EI</th>
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<td>S</td>
<td>200</td>
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</table>

This lecture gives an introduction to design flow for ASICs with tailored methods and tools. In particular methods for specification, behavioural modelling, re-use, consideration of constraints, design improvement, and design for synthesis, testability as well as verifiability are explained. Typical design tasks are solved in exercises. Finally each student has to solve an design task using design systems (e.g. Synopsys, Mentor, …) for a successful conclusion of this course.

**Examination:** oral

**Language:** German

**Prerequisites:** mathematics, electrical engineering I, II, III, system theory, digital circuit design

**Lecturer:** Elst

### 12 08 22  Laser Metrology

**Lasermesstechnik**

<table>
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<th>EI</th>
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<th>Term</th>
<th>Credits</th>
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<tr>
<td>W</td>
<td>210</td>
<td>4.5</td>
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</table>

The course will give an overview about the current state-of-the-art of laser metrology. It will start with a short introduction to the field of optics and laser physics. Opto-electronic devices for generating, modifying and detecting light will be presented and the fundamentals of light-matter-interaction will be discussed. Standard methods in research and application for measuring distances, shapes, velocities, forces, stresses, temperatures and chemical concentrations will be reported. Geometrical-optical measurement principles like triangulation sensors, time-of-flight sensors, fibre sensors will be presented as well as coherent, phase-evaluating methods like interferometry. Special emphasis will be drawn on Doppler methods for measuring velocity fields in fluid flows.

The lecture is accompanied by an exercise which will treat selected topics more detailed. A laboratory presentation will be offered.

**Examination:** oral

**Language:** German

**Prerequisites:** basics in mathematics, physics and electrical engineering

**Lecturer:** Czarske
12 08 23 Advanced seminar on Measurement Technology
Messtechnisches Oberseminar

El LCS W 020 3 cr

- Content is under construction.

examination: language: German
prerequisites: 
lecturer: Czarske

12 08 24 Processor Arrays
Zellulare Prozessoren

El LCS S 200 3 cr

This course deals with the systematic mapping, evaluation and exploration of massively parallel processor array architectures that are designed for compute-intensive applications. Processor arrays consist of massively parallel networked processing elements that, using today's hardware technology, may be implemented on a single chip (System on a Chip). The course provides the methods for mapping compute-intensive algorithms to parallel processor arrays. It starts with the description of the compute-intensive algorithms in form of nested loop programs. Algorithms transformations including partitioning and the inclusion of hardware- and algorithm- constraints in the design process are the main features treated in the course. The implementation in dedicated hardware or the implementation on array-like processing architectures such as fine-grain FPGAs as well as the exploration of subword parallelism are considerd.

examination: written language: German
prerequisites: mathematics, informatics
lecturer: Merker

12 08 25 Electronic Logic Systems
Digitale Systeme

El LCS S 110 W 001 4.5 cr

The course provides in short form selected facts and important relationships in the field of combinational and sequential circuits. Combinational logic: Boolean algebra, useful ways of representation, methods and procedures for design and for optimization of logic circuits, realization by means of various logic modules, fault detection and localization. Sequential circuits: MEALY machine and MOORE machine, state equation and change function, state tables and graphs, characteristic behaviour of Flip-Flop-circuits, design, reduction, realization of sequential circuits. Laboratory: design, realization, investigation of sequential Circuits with a given set of components.

examination: written language: German
prerequisites: systems theory, digital circuits
lecturer: Merker
| 12 08 26 | **Automatical Measurement and Testing**  
|          | Automatische Mess- und Prüftechnik |
| EI       | LCS | W | 1 0 1 | 3 cr |
| examination: |     |    |       |      |
| prerequisites: |     |    |       |      |
| lecturer: | Czarske/Leuterer |

*Content is under construction.*

| 12 08 27 | **Devices and Measuring of Quantum Optics**  
|          | Quantenoptische Bauelemente und Messverfahren |
| EI       | LCS | S | 2 0 0 | 3 cr |
| examination: |     |    |       |      |
| prerequisites: |     |    |       |      |
| lecturer: | Czarske/Leuterer |

*Content is under construction.*
12 09 01  System Theory I, II  
Systemtheorie I, II
EI  LASC  W  2 1 0  S  2 2 0  10.5 cr
This course of lectures provides basic knowledge of mathematical description and modelling of dynamic processes. Special emphasis is on uniform methods of mathematical description of various systems on the basis of some fundamental principles (transform methods, state variables, etc.) The arrangement of the contents concerning as well discrete and continuous time as well as discrete and continuous signal values leads to a clear classification of systems, at which in each class static and dynamic behaviour will be distinguished. In exercises, knowledge provided in the lectures is practised and increased.

examination:  written  
language:  German

prerequisites:  mathematics, electrical engineering

lecturer:  Hoffmann

12 09 02  System Theory III  
Systemtheorie III
EI  LASC  W  2 2 0  6 cr
The lectures introduce the fundamentals of the theory of stochastic processes and methods of their mathematical description (probability density function, correlation function, spectral density, etc.) In particular, they concentrate on stochastic signal processing by nonlinear static systems (transformation of the probability density function) and linear dynamic systems (transformation of the spectral density). In the practical exercises, the use of mathematical methods is consolidated.

examination:  written  
language:  German

prerequisites:  mathematics, electrical engineering I, II, III, system theory I, II

lecturer:  Hoffmann

12 09 03  Acoustics  
Akustik
EI  LASC  W  2 1 0  4.5 cr
This course deals with the general fundamentals of the acoustics, both for the students of acoustics as well as for students of adjacent disciplines, e. g. communications, biomedical engineering, civil engineering, mechanical engineering, environment technology. The subject of the lectures is the phenomenon "sound", especially the sound propagation in fluids and in solids, furthermore the branches electroacoustics and sound propagation. The lectures also includes some fundamentals of the physio-logical and psychological acoustics as well as some important basic methods of the acoustics (similarity and scale models, analogy methods, principle of reciprocity).

This course of lectures provides basic knowledge of acoustics, the foundation for the continuing lectures in the field of technical acoustics.
12 09 04 Signal Processing
Signalverarbeitung

**EI LASC W 2 1 0  4.5 cr**
This course introduces to signal processing in time and frequency domain. The first part covers sampling and reconstruction as well as a short introduction to statistical methods. The second part introduces in analog and discrete Fourier analysis with special respect to applications. Finally, an overview on Digital Filter theory and practice is given.

- **Examination:** written
- **Language:** German
- **Prerequisites:** system theory
- **Lecturer:** Hoffmann

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12 09 05 Signal Processing (in English)
Signal Processing, englisch

**EI LASC S 2 1 0  4.5 cr**
This course introduces to signal processing in time and frequency domain. The first part covers sampling and reconstruction as well as a short introduction to statistical methods. The second part introduces in analog and discrete Fourier analysis with special respect to applications. Finally, an overview on Digital Filter theory and practice is given.

- **Examination:** written
- **Language:** English
- **Prerequisites:** system theory
- **Lecturer:** Hoffmann

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12 09 06 Technical Acoustics
Technische Akustik

**EI LASC W 2 1 0  4.5 cr**
This course covers the scientific fundamentals of technical acoustics, ranging from basic equations of fluidmechanics and acoustics to modeling of sound fields in an infinite medium and in rooms. On the basis this general fundamental equations the lectures concentrate on the problems of radiation, propagation, reflection, transmission, refraction, scattering, isolation and absorption of sound waves.

- **Examination:** written
- **Language:** German
- **Prerequisites:** mathematics, physics, fundamentals in electrical engineering, acoustics
- **Lecturer:** Pfeifer
Acoustics Laboratory
Praktikum Akustik

EI LASC W 0 0 3 4.5 cr

The acoustics laboratory includes experiments carried out of all workgroups of the institute, i.e., the laboratory units cover the fields of technical acoustics, electromechanical systems and speech communication. The first unit comprises a series of varied experiments on the measurements of fundamental acoustical quantities, e.g., reverberation time, sound absorption coefficient, sound pressure and sound power level, sound intensity. Furthermore the second unit includes following experiments among other things: impedance tube (KUNDT), behaviour of the electrodynamical loudspeaker, mechanical resonance systems, electrodynamical vibration generator. The third laboratory work unit concentrates on the signal analysis, the signal transformation, the parameters of stochastic signals, the speech signal processing and the speech signal generation.

examination: oral language: German
prerequisites: physics, foundations of acoustics, technical acoustics, electroacoustics, signal analysis, signal processing
lecturer: Hoffmann, Pfeifer

Electroacoustics I
Elektroakustik I

EI LASC W 2 1 0 4.5 cr

The course describes the technical construction, mode of action and transfer function of sound and vibration transducers for airborne sound and solid-borne sound. Mechanical and acoustical systems are treated as networks consisting of basic structural elements. They are described with the methods of electrical network theory and field theory. Moreover, the lectures deal in detail with electrodynamical transducers (e.g. loudspeaker, microphone, bass-reflex box), electrostatical transducers with membranes (e.g. condensor microphone) and piezoelectrical transducers.

examination: written language: German
prerequisites: basics in electrical engineering, acoustics
lecturer: Pfeifer

Communication Acoustics
Kommunikationsakustik

EI LASC S 2 0 0 3 cr

Communication acoustics focuses on those aspects of acoustics which are relevant for research and development of modern information and communication technologies. The perspective taken here is the one of the listening and communicating user: How do listeners process acoustic-auditory events when they treat them as information carriers, which meaning do they assign and how do they react? The communication behaviour of listeners is a source of knowledge for modern communication technologies because their aim is to model communication processes for interactive man-machine systems. This lecture introduces different aspects of communication acoustics, starting off from auditory profiles and ending with acoustic system specifications.

examination: oral language: German
prerequisites: acoustics
lecturer: Jekosch
12 09 13  Noise Measurement Techniques
Schallmesspraxis

EI  LASC  W  0 1 1  3 cr
The aim of the exercises is to provide knowledges of practical application of the acoustic fundamentals to noise measurement techniques. With special regard to evaluation of environmental and industrial noise the use of acoustical devices and the measuring of basic and derived quantities are demonstrated. Taking the conditions of standardized rules into considerations, the measuring requirements are discussed. Starting from definition, the determination and presentation of values are described. The handling of devices and the measuring process are trained by practical tests. Recent developments are discussed with special regard to hearing damage due to noise.

examination: oral
language: German
prerequisites: physics, mathematics, foundations of acoustics
lecturer: Fuder

12 09 15  Ultrasonic I
Ultraschall I

EI  LASC  W  2 0 0  3 cr
This lecture consists of 2 parts:
1) foundations of wave propagation
2) testing by means of ultrasound, measuring technology and application of ultrasound
The lecture shows different applications of ultrasound in medical diagnostics and non-destructive testing of materials.
Structure of course:
- application of ultrasound in medical diagnostics and non-destructive testing of materials
- geometrical principles of reflection and refraction
- foundations of wave propagation in fluids and solid media
- sound fields of point and extended sources, sound field of complex testing problems
- ultrasound transducer, piezoeffect
- measuring technology by means of ultrasounds, signals processing
- digital systems of ultrasounds, Doppler, sonography
examination: written
language: German
prerequisites: foundations of acoustics or biomedical technology
lecturer: Kühnicke

12 09 16  Ultrasonic II
Ultraschall II

EI  LASC  S  2 0 0  3 cr
The lectures in this course are oriented to sound field modeling of ultrasound transducers. The sound field theory is important by the design and optimization of transducers and the evaluation of measured signals. The course includes 3-dimensional wave propagation in layered media. Different algorithms are discussed to solve the boundary value problem. The course contains the calculation of fields of point sources (Green's function) for half space and plates. The field of an extended source area results from the overlaying of the fields of point sources. The sound fields of ultrasound transducers are calculated in layered media with non-parallel and curved interfaces.

examination: oral
language: German
This lecture shows the different methods and applications of ultrasound in medical diagnostics and non-destructive testing of materials. The most applied technique is an impulse-echo-method. A lot of new methods have been developed in the last 10 years, for example: in new signal processing, in excitation and reception of ultrasounds.

Structure of course:
- Non-destructive testing of materials, time of flight diffraction, ultrasound generated by laser, scanning types by means of laser
- Medical diagnostics (ultrasound Doppler and sonography, High Frequency Imaging, Harmonic Imaging, signals coding, transmission-camera)
- Ultrasound application in the signal processing and in the measuring technology, SAW

examination: written language: German
prerequisites: Ultrasonic I
lecturer: Kühnicke

The subject of this lecture is the application of the methods of theoretical acoustics to the description of acoustical problems. Its objective is to represent the facts of acoustical phenomena and to discuss any problems in science and engineering. Very important is also the mathematical point of view, the working out of the intermediate steps by means of equations and algorithms (especially the wave equation - homogeneous, inhomogeneous, the Kirchhoff-Helmholtz integral theorem of sound radiation, integral transform methods). An introduction is given also in BEM and FEM.

examination: oral language: German
prerequisites: mathematics, physics, technical acoustics I, analytical and numerical methods
lecturer: Kühnicke

Signal processors are microprocessors having a specialized architecture for requirements of digital signal processing. They are necessary especially in real time applications, e.g. in speech processing. In this sense, this practical introduction to signal processors complements the lectures on signal processors.

The laboratory part deals with a 32 bit floating point processor.

examination: oral language: German
prerequisites: signal processing, computer engineering
lecturer: Hoffmann / Kürbis
Psychoacoustics
Psychoakustik

This is a short introduction in fundamentals of hearing and acoustic perception and covers in detail: Fundamentals of perception, human hearing, loudness and pitch of simple sounds, perception of complex sounds, tone colour, time effects in perception, spatial hearing. The presentation is supported by numerous acoustic demonstrations.

examination: written
language: German
prerequisites: Foundations of acoustics
lecturer: Attinsoy

Signal Analysis and Recognition
Signalanalyse und -erkennung

This course continues the basic course on signal processing as follows: short time spectral analysis, special topics of signal analysis (Cepstrum, LPC, Hilbert transform, etc.), fundamentals of pattern recognition (classification based on distances in feature space, Bayes-based classification strategies). Examples are mostly directed to applications in the field of acoustics.

examination: written
language: German
prerequisites: signal processing
lecturer: Hoffmann

Speech Synthesis
Sprachsynthese

This course continues and extends the fundamentals of speech synthesis started in the lectures of the course “Technical Speech Communication”: speech synthesis strategies, speech synthesis units and inventory, linguistic-phonetic transform/phonetic-acoustic transform of a text-string as input information.

examination: written
language: German
prerequisites: technical speech communication, signal analysis and recognition
lecturer: Hoffmann / Kordon

Technical Speech Communication
Technische Sprachkommunikation

This course focuses to the communication aspects of speech. It describes the human speech production process as well as its modelling by (linear) models. These fundamentals are applied to technical aspects like speech recognition and speech synthesis. The lecture is supported by laboratory exercises on the speech signal and its representation, computerized speech signal processing, features of speech for recognition purposes, theory and practice of speech recognition, speech synthesizing.

examination: written
language: German
prerequisites: technical speech communication, signal analysis and recognition
lecturer: Hoffmann / Kordon
12 09 24  **Speech Recognition I**  
Spracherkennung I

EI   LASC   W  2 0 0  3 cr

Speech recognition is a special domain of pattern recognition. To cover this field, the fundamentals of pattern recognition from the lecture “Signal Analysis and Recognition” will be continued to classification of feature sequences. In a first part the lectures are treating with increased algorithms of pattern recognition fundamentals like learning strategies and operations in feature spaces (vector quantization, feature transforms). The second part of the lectures deals with algorithms which are useful for speech recognition like Dynamic Programming, Hidden Markov Modelling and applying Neural Networks.

examination: written  
prerequisites: technical speech communication, signal analysis and recognition  
lecturer: Hoffmann / Kordon

12 09 25  **Speech Recognition II**  
Spracherkennung II

EI   LASC   S  2 0 0  3 cr

Basing on the signal near methods introduced "Speech Recognition I", this course focuses on the structures of speech and language and the higher, symbolic levels of automatic speech processing. It covers the fields of lexical and language modeling, syntax and semantics as well as advanced processing techniques like symbol sequence statistics, finite state machines and structure learning. Selected aspects of graph theory, the theory of formal languages and artificial intelligence will be covered as well.

examination: written  
prerequisites: speech recognition I, speech synthesis  
lecturer: Hoffmann / Wolff

12 09 26  **Chaos - Nonlinear Systems**  
Chaos - Nichtlineare Systeme

EI   LASC   W  2 0 0  3 cr

The idea of this course is to extend the student's perspective to problems and features which are specific to nonlinear dynamic (discrete and analogue) systems, such as coexisting asymptotic solutions and chaotic behaviour. General system theoretic terms, like stability (in the sense of Lyapunov), orbital stability, bifurcation and attractor, are introduced. Further tools suitable for the analysis of nonlinear system are provided for the engineer including Lyapunovs 1st. and 2nd. method as well as Volterra series.

examination: oral  
prerequisites: mathematics, system theory I/II  
lecturer: Hoffmann / Feldmann
12 09 27 Advanced Seminar: System Theory - Speech Technology – Communication Acoustics
Hauptseminar: Systemtheorie - Sprachtechnologie - Kommunikationsakustik

This seminar deals with advanced topics in system theory and speech processing. The scope reaches from general views and approaches, e.g. ‘analysis by synthesis’, to very specific problems and their solutions in speech analysis and synthesis, e.g. the task to model prosodic behaviour.

Each student is supposed to give a 20 minutes talk on one of the seminar topics followed by a discussion.

examination: oral
prerequisites: signal processing
lecturer: Hoffmann, Jekosch, Feldmann

12 09 28 Acoustic Radiation and Room Acoustics
Beschallungstechnik und Raumakustik

- Content is under construction.

examination: oral
prerequisites: signal processing
lecturer: Jekosch

12 09 29 Musical Acoustics
Musikalische Akustik

- Content is under construction.

examination: oral
prerequisites: signal processing
lecturer: Jekosch

12 09 30 Vehicle Acoustics (NVH)
Fahrzeugakustik

Vehicle acoustics plays a pronounced role in vehicle development. It requires an understanding of the sound generation, transmission (airborne & structure-borne) and radiation characteristics of the noise sources in the vehicle. The Transfer Path Analysis and Simulation techniques have been developed for the prediction of sound quality in vehicles, not only in terms of numbers and graphs, but also for binaural auralization. Evaluation of sound and vibration in passenger car cabins is an essential part of the sound design process. The aim of this seminar is to introduce the vehicle acoustics and NVH methodologies from sound pressure level measurement to cooperate sound development.
Sound design constructs audibility of the world. Sounds carry information about the world. When listening to sounds, communication takes place. These are well-known facts for speech sounds, but it is also true for other types of sounds such as music or product sounds. In principle, each acoustic event can be perceived as a sign carrier through which information about the world is communicated. In its ultimate sense, sound designers are engineers of communication. To be successful, they have to take design decisions on the basis of how listeners perceive sounds and of what kind of communication takes place during this event. Successful sound design requires a special view on acoustic/auditory communication.

The term virtual reality is related to that kind of technology which generates signals via the computer and offers them to perceiving human beings in such a way that they are physiologically adequate. Physiologically adequate means that the forms of the artificial signals are as close to natural sounds as necessary to generate a virtual reality in the minds of the perceiving human beings. Consequently, the task here is to know which information the perceiving human beings need to forget their natural environment in favour of the newly constructed illusion (immersion), and, even more, which specific signal characteristics simply destroy this illusion. In this seminar, we put main emphasis on acoustic-auditory information, without neglecting optical-visual and vibratory-tactile events.

Engineers of information and communication systems have a vivid interest to know how users will judge system quality even before new technology is offered to the market. Thus, one important aim is to obtain findings on how system quality assessment can be performed in a controlled way, e.g., in a laboratory, without these judgements losing meaningfulness when compared to randomly achieved judgements in natural environments. The supporting scientific field is communication acoustics. It is oriented towards the processes determining sound quality perception both in natural and artificial situations. The
most pressing aim is to examine and understand the processes of perception and assessment, gathering and including basic knowledge pertinent to acoustics, psychoacoustics, to the theory of perception, metrology and system design.

examination: oral

prerequisites: Fundamentals ind acoustics

lecturer: Jekosch

language: German
12 10 01 Communications
(Nachrichtentechnik)

This course introduces the fundamentals of communications, signals and systems. The following topics will be covered: mathematical and theoretical basics, properties of analog and digital signals using time- and frequency domain representations, signal transmission through linear time-invariant systems, sampling theorem, analog modulation (e.g. AM, FM), digital modulation (e.g. amplitude shift keying, frequency shift keying, phase shift keying), properties of stochastic signals, networks and multiplexing techniques (ATM). Important features of analog and digital communications systems are described and emphasis is placed on system goals.

examination: written
language: German or English
prerequisites: Mathematics, physics, systems theory
lecturer: Fettweis

12 10 02 Linear Networks
(Lineare Netzwerke)

This course introduces in two fields of the theory of linear systems, electrical transmission lines and network synthesis:
Part 1 – The Electrical Transmission Line: Line constants and line equations, dynamical processes on lines, lossless and lossy lines, attenuation and distortion, stationary processes on lossless and lossy lines, Smith-diagram, line filters and couplers.

examination: written
language: German
prerequisites: mathematics, system theory, communications
lecturer: Thierfelder

12 10 03 Coding Techniques
(Codierungstechnik)

This course provides basic knowledge of information- and coding theory and introduces different applications in communication and measurements systems. The process of information transmission is described on the basics of probability and entropy from the source of messages over a discrete memory-less channel. The most important methods for source and channel encoding are examined: Huffman-algorithm, parity check codes, generator matrix-minimum distance, and error correction properties.
Algebraic structure of cyclic codes are provided as the fundamentals for the efficient feedback shift register techniques, used in encoding and decoding circuits.

**12 10 04 Fundamentals on High Frequency Techniques I**
Hoch- und Höchstfrequenztechnik I

EI   CL S  3 2 0    7.5 cr

Scattering parameter description of components and systems. Planar waveguides i.e. microstrip and coplanar lines. Microwave amplifiers. Noise in RF circuits. Phenomenological derivation of Maxwell’s equation. Solution types of the reduced wave equation (HELMHOLTZ equation) TEM, TE, TM and hybrid waves. Waveguides and resonators for microwaves. Optical fibres, optical communication.

Examination: written language: German
prerequisites: theory of electromagnetic fields, transmission line theory
lecturer: Schäffer

**12 10 05 Telecommunications**
Telekommunikation

EI   CL S  3 2 0    7.5 cr

Aims: Introduction to communications systems and networks using the OSI-stack as a description guideline.

Topics:

a) Information theory refresher, basics of coding
b) Transmission systems and components, analogue and digital systems
c) Multiplexing techniques
d) Circuit- and packet switching networks
e) Communications protocols, formal description techniques
f) Performance modelling basics, traffic engineering
g) Realization aspects of actual communication networks
h) Appendix: History and outlook of networks and services

Examination: written language: German
prerequisites: Communications, System Theory
lecturer: Lehnert

**12 10 06 Practical Experiments on Communications**
Praktikum Nachrichtentechnik

EI   CL W  0 0 2    3 cr

E1: Modulation and demodulation
E2: Dynamic processes on loss-free transmission lines
E3: Steady-state processes on loss-free transmission lines
E4: Customer premises networks (analogue subscribers)
E5: PCM voice transmission
E6: Digital baseband transmission
E7: Biterror rate in short optical Waveguides
12 10 07  Microwave Devices
Hochfrequenz-Bauelemente

EI   CL   S 2 0 0 3 cr
In this course the following devices mainly for microwave application are presented: passive electronic devices, as resistors, inductors and capacitors. Then tubes for transmitting application above 1kW, as triodes, tetrodes, magnetrons and klystrons. Next devices are discrete semiconductors, as pn-diodes, schottky-diodes, pin-diodes, step-recovery-diodes, varactor-diodes and transistors as BJT-transistors, HBT-GaAs-, GaAs-FET- and HEMT-Transistors. Last topic ist then an introduction to GaAs-MMIC's technology.

12 09 08  Satellite Location Systems
Satelliten-Ortungssysteme

EI   CL   S 1 0 0 1.5 cr
The course provides the physical basis of satellite systems and the technical realisation in diverse international systems for location and navigation. The course is arranged in following sections:
- Satellite orbits, reference systems for position and time, problems of transmission the information
- Surveillance of international global systems
- Global PositioningSystem (GPS) by USA
- Augmentation Systems for GPS, also the European System EGNOS and Eurofix
- Global Navigation Satellite System (GLONASS) by Russia
- European Satellite System "Galileo"
- Some examples for use of satellite systems

12 10 09  RF Measurements and EMC
Hochfrequenz-Messtechnik und Elektromagnetische Verträglichkeit

EI   CL   W 2 1 1 6 cr
In this course the following topics presented: measurement of RF voltage, current and power, frequency and phase measurements, detemring of electric and magnetic field strength, spectrum analysis, scalar and vector networ analyzers, noise and phase noise measurement, measurement of receiver parameters, technology for antenna research, detemring of electromagnetic compability (EMC). The laboratory practices are on field strength measurements, signal analysis in the frequency domain and network analysis with the slotted transmission line as also with the vector network analyzer.
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<th>Course Code</th>
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<tr>
<td>12 10 10</td>
<td><strong>Fundamentals on High Frequency Techniques II</strong></td>
<td>Measurement Techniques, RF and Microwave</td>
<td>oral</td>
<td>German</td>
<td>Theory of Electromagnetic Fields, Transmission Line Theory I</td>
<td>Schäffer</td>
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<td>Hoch- und Höchstfrequenztechnik II</td>
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<td></td>
<td>Kirchhoff diffraction integral, Gaussian beams.</td>
<td>Free space propagation of waves. RF links. Building blocks of microwave systems for example mixers, PLL’s oscillators etc.</td>
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<td>12 10 11</td>
<td><strong>Optical Waveguides</strong></td>
<td>Electromagnetic fields, System Theory, Waveguide Theory, Optics, Scattering Parameters</td>
<td>oral</td>
<td>German</td>
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<td>Schäffer</td>
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<td>Lichtwellenleitertechnik</td>
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<td>Attenuation and dispersion limited optical systems; Multimode dispersion, material dispersion, group index; scalar analysis of step index fibres, mode diagram, field distribution; single mode fibres; Material and waveguide dispersion and their compensation, near and far fields, effective cutoff wavelength; graded index fibres; profile optimization, leaky modes, phase space diagram; overview over optoelectronic components systems.</td>
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<tr>
<td>12 10 12</td>
<td><strong>Numerical Computation for RF and Microwave Design</strong></td>
<td>Theoretical Electrodynamics, RF and Microwave, Numerical Mathematics</td>
<td>oral</td>
<td>German</td>
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<td>Schäffer</td>
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<td></td>
<td>Numerische Feldberechnung in der Hochfrequenztechnik</td>
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<td>EI</td>
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<td>In this course the following topics mainly for field computation are presented: mathematical background of computation algorithms, basics of electrodynamics from Maxwell-Equation to dyadic-Greens-Function, short summary of principal numerical methods, introduction to finite-difference-method (FDM), finite-element-method (FEM) and moment method (MoM). Computational practices at the end of the lecture.</td>
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12 10 13  Photonics I
Photonik I

EI  CL  W  2 0 0  3 cr
Physical and technical laser foundations, including Fabry-Perot-Laser, mode locked lasers, fibre lasers and amplifiers; Bragg gratings analysis, DFB- and DBR-Lasers, fibre Bragg Gratings; Introduction into quantum mechanics based on analogy between Helmholtz and Schrödinger equation and their solutions; Double heterostructure, quantum well and quantum wire laser diodes; Matter fields of electrons in atom, quantum numbers, shell structure of atoms, designation for energy levels, e.g. for Er³⁺.

examination: oral
language: English
prerequisites: Radio microwave and lightwave techniques, foundations of atom physics
lecturer: Schäffer / Patela

12 10 14  Photonics II
Photonik II

EI  CL  S  2 0 0  3 cr
Different technologies for Integrated Optics (IO); analysis methods for waveguides of IO; components of IO; passive, switchable (on LiNbO₃) and active (on GaAs or InP substrates); superfast optical information processing; optical solitons, derivation of sech-shape technical application.

examination: oral
language: English
prerequisites: waveguide radio, microwave and lightwave techniques, optical fibre technique photonic I
lecturer: Schäffer / Patela

12 10 15  RF Laboratory Practices
Praktikum Hochfrequenztechnik

EI  CL  S  0 0 2  3 cr
This laboratory practices are connected with CAD of filters and amplifiers, RF receivers, antenna measurements and with propagation of electromagnetic waves in the microwave frequency range.

examination: oral
language: German
prerequisites: RF and Microwave, Microwave Devices, RF Measurements and EMC, Antennas, Propagation of Electromagnetic Waves
lecturer: Schäffer/Roßner

12 10 16  Fiber optic Communication Systems
Optische Breitbandkommunikation

EI  CL  W  2 1 0  4.5 cr
Fiber optic communications systems continues to evolve rapidly. The bitrate of point-to-point links has grown from 2.5 to 40 Gb/s and that figure is expected to more than double over the next two years. Future optical systems will be build on flexible optical links, transporting optical packets (IP). A future issue is the pure optical signal processing of...
information.
Contents of the lecture
-Synchronous optical Systems, Optical fibers (Dispersion, Nonlinear optical effects),
Channel Multiplexing, Modulations Formals, Network architectures, Optical signal
processing, introduction to Quantum, Informations theory, Quantum kryptography
examination: oral language: German
prerequisites: 
lecturer: Schäffer

12 10 17 Microprocessors and -controllers
Mikroprozessoren und Controller

EI   CL  S   2 0 0   W   0 0 1  4.5 cr
On the basis of fundamental courses on computer science this lecture deals with advanced
aspects in computer architecture for microprocessors and -controllers. Covered are
instruction set and micro architectures of current systems like Pentium 4, Itanium, Athlon 64
and others. The second part attends to specific features of microcontrollers and embedded
systems. For exemplary considerations we use the Infineon Microcontroller family C166.
During the practical course in winter semester students can exercise programming of
microcontroller systems (Personal Branche Exchange with C161, Peripheral components of
C167)
examination: written/oral language: German
prerequisites: Computer Science
lecturer: Lehnert/Schingnitz

12 10 18 Statistics I
Statistik I

EI   CL  S   2 1 0  4.5 cr
This course serves as an introduction into the foundations of Mathematical Statistics, i.e.
into advanced probability theory. To attend „Statistics II“ afterwards is very recommended.
The following topics will be covered:
Additional facts to probability theory (theory of combination, independent and uncorrelated
random variables, important selected probability distributions and their parameters,
normalized random variables, definition of quantils, asymptotic theorems, stochastic
convergence, laws of large numbers);
Describing Statistics (description and parameters of empiric probability distributions of one
or two features, regression and correlation).
Exercises from the field of electrical engineering and information technology are to
demonstrate the mathematical relationships and consolidate the acquired knowledge.
examination: written language: German
prerequisites: mathematics, fundamentals of probability theory
lecturer: Lehnert/Schingnitz
In sequel to the course „Statistics I“ this lecture provides a survey of the most important methods for statistical estimations and for statistical tests of various parameters. The following topics will be covered:

- Fundamental terms and principles (statistical inferences, sampling vector and -function);
- Estimation procedures (estimators, properties of evaluation functions, parameter evaluation, confidence intervals and prediction intervals);
- Statistical tests (testing of hypotheses about expectation values, variances and partition values, errors of first and second kind, assessing of parameter tests, matching tests);
- Investigation of stochastic correlations (confidence intervals and hypothesis tests of correlation coefficients and regression coefficients).

Exercises from the field of electrical engineering and information technology are to demonstrate the mathematical relationships and consolidate the acquired knowledge.

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**Modelling and Simulation of Telecommunication Networks**

Aims: Understanding the principles of Discrete Event Simulation techniques and time series analysis, getting acquainted with a DES simulation language.

Topics:
1. Simulation Basics: Modeling techniques and model elements of communication systems, analytical approaches, simulation techniques, historical overview, Monte Carlo Method, discrete event simulation, time advancing mechanisms, event transition mechanism, event list management, simulated and computer time
2. Random Number Generators: Basic generators, generating random variates with given probability distributions, inversion method, generator method
3. Introduction to GPSS/H and Proof Animation: Block structure, basic blocks, block diagram, queueing systems with GPSS/H, output analysis
5. Special Simulation Techniques: Rare-Event Simulation, Non-Stationary Simulation, Distributed Discrete Event Simulation, Functional Partitioning, Evaluation Partitioning, Model Partitioning
6. Overview of Simulation Languages, Packages, and Tools

Exercises (partially computer-based)
12 10 21  Network Planning
Planung von Kommunikationsnetzen

EI   CL   W   2 1 0   4.5 cr
Aims: Understanding the steps and algorithms to optimize backbone and access networks.
Topics:
1. Introduction: Existing networks, network architectures, typical questions of optimization, optimization methods, modern heuristics
2. Graphs und Routes: Formal description techniques of graph theory, path finding principles, traffic requests and flows
3. Optimum Arcs: Minimum spanning trees, optimum multipoint routing, optimum graphs with flows
4. Short intro to Traffic Engineering: economy of scale, overflow traffic, dimensioning of overflow routes
5. Optimum Nodes (Clustering): Coordinate systems for node locations, the concentrator problem, access network structuring
6. Availability an Reliability: Modelling, definitions, reliability parameters in networks, probabilistic measures
7. Forecasting: Methods, curve fitting, extrapolation
Exercises: Examples for algorithms and usage (computer based)
examination: written language: German
prerequisites: Telecommunications, System Theory
lecturer: Lehnert

12 10 22  Transmission Technology
Übertragungstechnik

EI   CL   W   2 0 0   3 cr
The course introduces fundamentals and operational principles of wire-line transmission systems. The first part recapitulates and extends knowledge of the theory for digital transmission via copper cables (baseband and passband transmission, multi-carrier modulation, DMT/OFDM modulation details) and via optical fibres (fibre characteristics, dispersion planning, active optical components, WDM). Transmission system aspects then are discussed in the second part. Studied topics comprise details of an ADSL system, synchronization principles in SDH networks, routing and wavelength assignment in photonic networks, optical burst switching, and protection / restoration mechanisms for transport networks.
examination: oral language: German
prerequisites: System theory, Telecommunications
lecturer: Lehner/Baumann

12 10 23  High Speed Networks I
Hochgeschwindigkeitsnetze I

EI   CL   W   2 0 0   3 cr
The aim of the course is to provide knowledge of theoretical fundamentals and technical realisation of high speed networks. We focus on net-oriented layers and functions of well known and developing network technologies. Covered are medium access methods and standards in local area (Ethernet, Token Ring, Token Bus) and metropolitan area and hybrid systems (DQDB, FDDI-I, FDDI-II, Frame Relay, ATM) as well. Some aspects of
internetworking (routing) and IP-networking (TCP/IP-protocol stack) are considered.

examination: written
language: German
prerequisites: Telecommunications
lecturer: Lehnert/Schingnitz

12 10 24  High-Speed Networks II
Hochgeschwindigkeitsnetze II

EI  CL  S  2 1 0  4.5 cr

The course discusses advanced topics in high-speed packet networking, covering the essential elements of future multi-service packet networks. The following issues are studied in detail: flow and congestion control for elastic and inelastic traffic; TCP throughput analysis; quality-of-service (QoS) architectures for IP networks; packet scheduling and corresponding traffic theory (network calculus) for rate and delay guarantees in IntServ and DiffServ networks; unicast and multicast routing with QoS support; hardware and software architectures for high-speed packet routing and switching.

The course closes with student presentations concerning recent scientific and technological developments.

examination: oral, project seminar
language: English
prerequisites: Telecommunications, High-Speed Networks I
lecturer: Baumann

12 10 25  Teletraffic Engineering I
Nachrichtenverkehrstheorie I

EI  CL  W  3 1 0  6 cr

This course serves as an introduction into the foundations of teletraffic engineering, congestion theory, respectivly, i.e. into theory of stochastic processes and in particular of Markovian chains. To attend „Teletraffic Engineering II“ afterwards is very recommended. The following topics will be covered:

Examplaric problems of teletraffic engineering and their solutions, assignment and delimiting;
Selected areas of Stochastics (e.g. basic probability distributions in teletraffic engineering, outstanding roles of Exponential and POISSON distribution, functional transformations);
Stochastic Processes in general and Markovian processes in particular (stationarity, Markovian property, Chapman/Kolmogorovs equations, stationary distributions);
Homogeneous Markov chains with discrete time (properties and laws).

Exercises are to demonstrate the mathematical relationships and consolidate the acquired knowledge.

examination: written
language: German
prerequisites: mathematics, fundamentals of probability theory
lecturer: Lehnert/Baumann
12 10 26 Teletraffic Engineering II
Nachrichtenverkehrstheorie II

EI   CL   S   3 1 0   6 cr

In sequel to the course „Teletraffic Engineering I“ this lecture provides further important prerequisites for the performance evaluation of communication systems. The following topics will be covered:
Homogeneous Markov chains with continuous time (intensity, system of differential equations for state probabilities and transition probabilities, local and global balance conditions for stationarity, birth and dead processes, multidimensional Markov chains);
Foundations of renewing theory; Generation, transformation and test of random numbers;
Communication as a queueing process (structure, function and naming of queueing systems; parameters for performance evaluation and relationships; methodology of handling queueing problems; investigation of special selected queueing systems);
Exercises are to demonstrate the mathematical relationships and consolidate the acquired knowledge.

examination: written
language: German
prerequisites: mathematics, fundamentals of probability theory, Teletraffic Engineering I
lecturer: Lehnert/Baumann

12 10 27 Integrated Services Digital Network (ISDN)
Dienstenetzintegrierende Nachrichtennetze (ISDN)

EI   CL   W   2 1 0   4.5 cr

The aim of the course is to provide knowledge of theoretical fundamentals and technical realisation of Integrated Services Digital Network (ISDN). In this context the lecture deals with principles, technologies and standards of recent digital systems with service integrating abilities, concerning switching, signalling and control. Covered are considerations of user-network- and network-network-interfaces and their signalling transactions. Some aspects of broadband (B-ISDN) and intelligent (IN) networks are discussed.
The exercises should support the theoretical considerations and provide some insight into programming a small digital PBX and measuring and analysing ISDN-protocols with a protocol analyser.

examination: written
language: German
prerequisites: Telecommunications
lecturer: Lehnert/Schingnitz

12 10 28 Telecommunications Laboratory
Praktikum Telekommunikation

EI   CL   W   0 0 1   S   0 0 1   1.5 cr
Aims: Experimenting with actual telecommunications systems.
Method: Preparation using supplied material and former course material, Q&A with the supervisor, lab report
Laboratory Tasks:
1. DQDB MAN test network. Experiments with the network management system.
2. FDDI test network. Experiments on a small network including data transfer and network management.
3. ATM switch and traffic generator: Experiments with IP packet transmission over ATM and various traffic scenarios.
4. GSM test network: Analysis of protocols to handle subscriber registration, access and handover
5. Markov-Chains: Computer experiments on the analysis and behaviour of Markov-chains for the performance analysis of communication systems
Acceptance: 3 of 5 experiments successfully done

examination: oral language: German
prerequisites: Telecommunications, High-Speed Networks, Traffic Theory
lecturer: Lehnert

12 10 29 Hardware Software Co-design
Hardware Software Co-design

EI  CL  W or 1 1 0  S or 0 0 1
S 1 1 0 W 0 0 1 4.5 cr

The purpose of this lecture is to introduce fundamental concepts regarding the implementation of communications problems as systems comprising Hardware and Software. The main focus of the lecture is on both design approaches and their close interrelation (Co-design). In this context, typical Hardware and Software design methodologies are presented and compared. Additional laboratory practice offers the opportunity to get acquainted with implementation issues related to the theory discussed in the lecture.

examination: oral language: English
prerequisites: -
lecturer: Fettweis, Robelly

12 10 30 Digital Communications
Digitale Signalübertragung

EI  CL  S 2 1 0 4.5 cr

This lectures cover principles for digital transmission over a noisy (AWGN) channel. Possible distortions and countermeasures are treated for baseband transmission, resulting in the design principles for transmit and receive filters. Different digital modulation methods are investigated with respect to their robustness and spectral efficiency based on a vector signal representation of the baseband signal. After a short introduction into detection theory, decision criteria will be developed for designing optimum receivers. Finally, basic methods for synchronization will be treated in the framework of estimation theory.

examination: written language: German
prerequisites: Communications, Systemtheory III
lecturer: Nuszkowski
12 10 31  **Radio Communication Systems**  
Rundfunksysteme

**El  CL**  
S  2 0 0  3 cr

This course of lectures provides an overview of existing broadcast and mobile radio systems. The great variety of systems (analogue, digital, terrestrial, satellite) is presented and their different features are characterized. The international standards, system parameters, signal structures and signal processing methods of these systems are presented in detail.

examination: written  
language: German

prerequisites: Communications

lecturer: Nuszkowski

12 10 32  **Communications Seminar**  
Nachrichtentechnisches Seminar

**El  CL**  
W  0 1 0 or S  0 1 0  1.5 cr

This seminar provides recent issues, solutions and methods in communications systems which go beyond the corresponding lectures. Selected research topics will be presented on:
- methods in signal processing
- communications methods
- application specific signal processors
- software tools

examination: -  
language: German or English

prerequisites: Communications

lecturer: Matus

12 10 33  **Smart Antennas**  
Smart Antennas

**El  CL**  
W  2 1 0  4.5 Cr

This course presents antenna array techniques starting from beamforming methods to multi-antenna transmission techniques (MIMO). Topics covered are: description of signals in space and time and its dual in frequency and wavenumber space, antenna aperture and resolution, effects of spatial sampling, delay&sum beamforming, time and frequency domain beamforming, estimation of arrival methods (minimum variance beamformer, MUSIC, ESPRIT), adaptive methods (LS, RLS, LMS algorithm), receive vs. transmit diversity, space-time codes, MIMO capacity, spatial multiplexing (V-BLAST architecture).

examination: oral  
language: German

prerequisites: Systems theory, mathematics

lecturer: Rave

12 10 34  **Estimation and Detection**  
Estimation und Detektion

**El  CL**  
S  2 1 0  4.5 cr

This course introduces the fundamentals of estimation and detection, both fields being representative examples of statistical signal processing. The discussed concepts are the basis of many algorithms employed in communications receivers. After a short introduction,
the course starts with the area of detection theory, more specifically the idea of Bayes risk, the MAP and the ML detector, as well as the Neyman-Pearson Theorem for binary hypothesis testing. This is followed by a discussion of maximum likelihood sequence estimation algorithms (Viterbi, BCJR) and iterative techniques. Subsequently, relevant estimation concepts are presented, such as Bayesian MMSE, ML and MAP estimators (scalar and vector case) and linear estimation algorithms (BLUE, Linear Least Squares). Relevant performance criteria (bias, minimum variance, Cramer-Rao Lower Bound) are introduced. Finally, an overview of Wiener Filtering and Kalman Filtering is given.

examination: Oral
language: English or German
prerequisites: communication theory, mathematics (linear algebra, statistics)
lecturer: Fettweis/Zimmermann

12 10 35 High Frequency Circuits
Hochfrequenz-Baugruppen

EI CL W 2 1 0 4.5 cr
This course of lectures deals with the design and analysis of the fundamental function units of high frequency receivers and transmitters such as matching circuits, filters, small signal and power amplifiers, mixers, frequency multipliers and oscillators. The technology of these components depends on the frequency used and is studied in the classical VHF and UHF frequency domain as well as for microwave realizations. Exercises supplement the lectures to provide the students with a further insight into the theory. The laboratory "CAD of microwave circuits" gives the possibility to become familiar with modern CAD tools.

examination: written
language: German
prerequisites: communications, high frequency engineering
lecturer: Nuszkowski

12 10 36 Mobile Communications Systems I
Mobile Nachrichtensysteme I

EI CL W 2 1 0 4.5 Cr
The course serves as an introduction into mobile communications principles and focuses in particular on mobile communications systems. The following topics will be covered: characteristics of mobile radio channels, modulation schemes, channel access techniques, diversity and combining techniques, baseband receiver structures, and speech coding.

examination: oral
language: German
prerequisites: system theory, communications, digital communications
lecturer: Fettweis

12 10 37 Mobile Communications Systems II
Mobile Nachrichtensysteme II

EI CL S 2 1 0 4.5 Cr
This course provides an overview over existing and future mobile communications systems. The following topics will be covered: fundamentals of cellular wireless systems (propagation, frequency reuse, handover), system architectures (GSM, GPRS, UMTS), network capacity (e.g. blocking probabilities, soft capacity), radio network planning, capacity
enhancing measures (e.g. diversity), handover mechanisms, current research activities and outlook to future systems. The course is partly held by guest lecturers from industry; this provides practical and interesting insights into the discussed problems.

examination: oral
prerequisites: Communications, digital communications, systems theory
lecturer: Fettweis, Herhold

12 10 38  Seminar Mobile Communications Systems
Seminar Mobile Nachrichtensysteme

This seminar complements the lectures on Mobile Communications Systems. Recent research results and special topics which are omitted in the lectures, will be presented by students. Another aim of this seminar is to learn how to prepare and give a scientific presentation. Each presentation (30 min) will be followed by a discussion (15 min). A short paper (6 -10 pages) have to be submitted in addition to the presentation slides.

examination: oral
prerequisites: Communications, Digital Communications
lecturer: Nuzskowski, Rave

12 10 39  Mobile Communications Systems Laboratory
Praktikum Mobile Nachrichtensysteme

This laboratory course is based on the lectures on Mobile Communications Systems. The main objective is the development of suitable modulator structures for the transmission of digital signals over a mobile radio channel. The system design will be implemented using the simulation software COSSAP on SUN-workstations.

examination: oral
prerequisites: communications, digital communications, mobile communications systems I
lecturer: Fettweis

12 10 40  Radio Network Planning
Funknetzplanung

This course introduces tools for radio network planning using GSM as a theme example. Topics covered are the cellular concept, trunking theory, propagation mechanisms such as the two-ray model and diffraction, multiple access schemes and the physical layer concept and system components of GSM and radio propagation and network simulation tools as optimization methods employed by the network operator. UMTS serves to compare differences between 2nd and 3rd generation systems.

examination: oral
prerequisites: Mobile communications I
lecturer: Rave
Part I of the course systems of digital signal processing is focussed on the theoretical fundamentals, basic algorithms and their computation: Introduction, digital signals and systems, A/D- and D/A-conversion, mathematically description of digital systems in the time and the frequency area, canonic and other basic structures of digital systems, block diagram and signal flow graph, digital filters, design and implementation of nonrecursive (FIR) and recursive (IIR) digital filters, digital simulation of analogue systems, discrete Fourier-transform (DFT), fast Fourier-transform (FFT), computing of the FFT, Goertzel-algorithm.

examination: written
prerequisites: mathematics, system theory, linear networks
lecturer: Thierfelder

Part II of the course systems of digital signal processing is focussed on add-ons of the theoretical fundamentals and the implementation and realisation of such systems with digital signal processors:

Lectures: Computer aided design of digital filters, fundamentals, architecture, performance, programming and application of digital signal processors (DSP), DSP-families DSP 56xxx and TMS 320xxx, high performance DSP, special circuits for DSP-systems, sigma-delta conversion, switched-capacitor filters, application of DSP in communications.

Laboratory:
- Design, implementation and verification of FIR- and IIR-digital filters
- Programming, debugging and verification of a program in assembler language for a DSP 56K from Freescale semiconductor

Characteristics, potentials and limitations of the FFT

examination: written
prerequisites: Systems of digital signal processing I
lecturer: Thierfelder

The course provides basic knowledge of special digital signal formats and sequences with "good" cor-relation properties:
- waveform representation of binary digits
- scrambling and synchronization codes
- linear recurring sequences, m-sequences (PN-PR-, linear feedback shift register-LFSR-Codes).
- code sequences for spread spectrum- and CDMA-systems, ranging and navigation systems, measurement and test systems.

Throughout the course, emphasis is placed on system goals and the usefulness of correlation signals.
12 10 44  Electronic Media / Digital Broadcast  
Elektronische Medien / Digitaler Rundfunk

EI   CL W 2 0 0 3 cr
This curse gives a comprehensive and topical overview about principles of analogue and digital broadcast systems for audio and video, their basic building blocks, and about media formats and compressions techniques for audio, graphics, and video. This includes: digitalisation of signals; lossless source coding (entropy, Huffman, Lempel-Ziv, run-length); human aural and visual perception, audio compression (MP3, AAC, voice compression); graphics compression (JPEG, JPEG-2000); video compression (MPEG-1, -2, -4); channel coding (information, capacity, linear block codes, convolutional codes, concatenated coding/interleaving, ARQ); analogue and digital modulation (AM, FM, M-PSK, M-QAM, OFDM), multiplex (S-/F-/T-/C-DMA); satellite based audio broadcast systems (DSR, ADR, WorldSpace, XM, Sirius, ARIB); terrestrial audio broadcast systems (AM, FM+RDS, iBOC, DRM, DAB); video broadcast systems (analogue TV, PAL, video-text, DVB-C, -S, -T, MHP); media streaming.

examination: written
prerequisites: Communications, mathematics
lecturer: Finger

12 10 45  Error Reduction Systems  
Fehlerreduktionssysteme

EI   CL W 2 0 1 4.5 cr
The lecture introduces fundamentals of the most important methods of error correcting codes as a cost-effective way of providing improvement in system error performance:
- Reed Solomon Codes
- Convolutional Codes and TCM
- BCH-Codes
The course also deals with applications in different communications systems (CD, DAB, DSR, RDS, GSM).
In the practical exercises, experiences will be given on Hamming Coding, BCH-Codes, RDS-Systems, Reed-Solomon Coding, and Convolution Coding.

examination: written
prerequisites: Coding techniques, communications, digital circuits
lecturer: Finger

12 10 46  Cryptology and Data Security  
Kryptographie und Datenschutz

EI   CL S   2 0 0 4.5 cr
This course provides basic knowledge of theoretical and practical security and introduces principal con-cepts of cryptosystems, symetric and asymmetric - secret key and public key. The need for cryptology and classic ciphers in the cryptologic history is briefly reviewed. The course also deals with the essential algorithms for crypto techniques in modern
communications: Data Encryption Standard (DES), the RSA-trapdoor one-way function and stream encryption schemes that employ shift registers for generating pseudorandom key sequences.

examination: written language: German
prerequisites: Mathematics, coding techniques
lecturer: Finger

12 10 47  Advanced Seminar on Communications and Coding Technology
Hauptseminar Theoretische Nachrichtentechnik / Codierungstechnik

EI  CL  W, or S  0 2 0  3 cr
This course is divided in two equal parts for lectures and exercises. The lecturing part follows the lecture “Coding Theory” and adds both facts in the theory of communications and knowledge about existing technical systems. This includes modulation, digital modulation, the validation of this methods, communications about bandwidth-limited channels, source and channel coding, communications for services with added value and digital broadcasting. In the lecturing part every student gets a topic for a presentation. The presentation will be prepared for the student’s active and successful participation in the part of exercises.

examination: successful participation language: German
prerequisites: mathematics, physics, system theory
lecturer: Hiller

12 10 48  Digital Communications Lab
Praktikum Digitale Signalübertragung

EI  CL  S  0 0 1 or 0 0 2  1.5 or 3 cr
This DSP lab course complements the lecture on Digital Communications. It consists of 4 basic labs, following an introduction on architectures and efficient programming techniques for digital signal processors:
- Pseudo random noise generator
- Sample rate conversion
- Synchronization
- Digital Modulation
After these basic labs a complex project can be conducted. (This will effectively double the credits.)

examination: - language: German or English
prerequisites: Programming language C, Communications, Digital Communications
lecturer: Nuszkowski

BACK TO PAGE: CONTENTS
12 11 01  Microtechnology
Mikrotechnik

EI  LSSE  S  2 1 0  4,5 cr
This course introduces the fundamentals of fabrication technology for microsensors and microactuators in microsystems technology. Based on the properties of relevant materials like silicon, the principles of microfabrication techniques will be explained. The course emphasizes the close relationship to conventional semiconductor fabrication techniques and shows the efforts to be made to create three-dimensional mechanoelectrical elements and devices.
examination: written  language: German
prerequisites: -
lecturer: Gerlach

12 11 02  Sensorics I
Sensorik I

EI  LSSE  S  2 1 0  4,5 cr
This course introduces the principles and methods, functions, properties, and applications of state-of-the-art sensors. Based on the “Electronic Devices” and “Semiconductor Electronics” courses, the interaction between physics, electronics and fabrication technology are shown which is crucial for sensor technology. The course covers fundamentals (measuring principles and methods, generalized sensor model, real sensor properties, uncertainty) and the two most important sensor groups (thermal and mechanical sensors).
examination: written  language: German
prerequisites: semiconductor electronics, electronic devices
lecturer: Gerlach

12 11 03  Sensorics II
Sensorik II

EI  LSSE  W  1 1 1  4,5 cr
“Sensorics II” continues the “Sensorics I” course. It introduces magnetic, optical and chemical sensors. The operation and practical handling of modern sensors are trained practically (Lab work: temperature sensors, pressure sensors, optical sensors, magnetic sensors, chemical sensors, humidity sensors).
examination: oral  language: German
prerequisites: Sensorics I
lecturer: Gerlach
12 11 04  Solid State Electronics  
Festkörperelektronik

EI  LSSE  S  3 1 0  6 cr
The course introduces the fundamentals of physical effects in solid-states and their application for electronic devices. The following topics will be covered: crystal properties, lattice dynamics, metals, dielectric properties and polarization, magnetic properties, superconductors.

examination: written  
language: German
prerequisites: Mathematics, physics, electrical engineering
lecturer: Gerlach

12 11 05  Infrared Measuring Technology I  
(Infrarotmesstechnik I)

EI  LSSE  W  2 1 0  4,5 cr
The aim of this course is to provide basic knowledge of operation and application of infrared sensors and devices for measuring problems in thermal imaging, pyrometry, gas analysis, IR-spectroscopy, and presence detection. The course covers the following topics: radiation physics fundamentals, infrared sensors, infrared measuring devices and systems, calibration.

examination: oral  
language: German
prerequisites: semiconductor technology, sensorics I
lecturer: Gerlach

12 11 06  Infrared Measuring Technology II  
Infrarotmesstechnik II

EI  LSSE  S  1 0 2  4,5 cr
The course continues the «Infrared Measuring Technology I» course by detailed consideration of the most important application fields for infrared sensors and systems: thermal imaging, pyrometry, gas analysis, IR spectroscopy, and presence detection. Lab exercises will train the skills to apply practically infrared sensors and cameras in important application fields (pyroelectric single-element and array sensors, IR imaging, emission coefficient influence in pyrometry, object-based errors in pyrometry).

examination: oral / lab work  
language: German
prerequisites: Infrared measuring technology I
lecturer: Gerlach
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The aim of the seminar is to deepen the understanding in sensor technology and to become familiar with particular developments of high importance. Supervised by the professor, students will prepare the fundamentals of special topics and fields including mathematical and physical basis, functional operation and application of sensors. At the end students will provide a written report and an oral presentation.

- **examination:** Report and presentation
- **language:** German
- **prerequisites:** Sensorics I
- **lecturer:** Gerlach
12 12 01  Semiconductor Technology I  
Halbleitertechnologie I

EI  SMTL  S  4 0 0  6 cr
Within the course, the basic technologies for IC manufacturing will be described. Major goal is the understanding of the physical and chemical context and interaction in the specific manufacturing technologies.
Specific Content:
- Manufacturing of the substrates
- Lithography
- Oxidation
- Deposition (PVD, CVD, Epitaxie)
- Doping (Diffusion and Implantation)
- Etching (Plasma)

examination: oral  
language: German or English

prerequisites: Intermediate examination, materials science II

lecturer: Bartha

12 12 02  Semiconductor Technology II  
Halbleitertechnologie II

EI  SMTL  W  2 0 1  4.5 cr
The course covers in general all issues connected to "process integration". To manufacture an IC, the individual technologies taught in "semiconductor technology 1" have to be applied in a specific sequence so that the appropriate electrical function can be fulfilled. The complex interaction for the manufacturing of DRAM SRAM and logic circuits in N-MOS and CMOS technology will be described. The interaction between physical function and methodology of the manufacturing sequence is especially pronounced at the modern self assembling techniques which will be discussed specifically.

examination: oral  
language: German or English

prerequisites: Intermediate examination, materials science II

lecturer: Bartha

12 12 03  Microsystems Technology  
Mikrosystemtechnik

EI  SMTL  W  2 0 0  S  0 0 2  6 cr
This course introduces the fundamentals of micro technologies, micro sensors and micro actuators. The following topics will be covered: definition, components, application fields and trends, basic technologies like etching processes (anisotropic silicon etching, plasma etching, RIE), micro technologies (e.g. bulk micromachining, surface micromachining, LIGA). Starting from these technologies and physical basics important integrated sensor and actuator systems (magnetic field-, pressure-, acceleration- and yaw rate-sensors, micro mirrors, micro motors ) are discussed. Various possibilities for miniaturized energy sources (miniature batteries, supercapacitors, solar cells, wireless energy supply) are introduced.
12 12 04  Materials of Electronics (Material science II)
Werkstoffe der Elektronik, Werkstoffe II

EI  SMTL  W  2 0 0  S  0 0 1  4.5
The course covers the basics of materials properties related to microelectronics and microsystem technology:
- Bonds in a solid state
- Conducting materials
- High purity of solid states
- Silicides
- Growing of single crystal
- Isolating materials
- Mechanical properties of solid states
- Contact materials
- Semiconductors
- Light waveguide materials

12 12 05  Material science III - Special Materials of Electronics
Spezielle Werkstoffe der Elektronik, Werkstoffe III

EI  SMTL  S  2 1 0  W  0 0 1  6 cr
The course deals with very special problems of materials in microelectronics and microsystem technology:
- SiO₂ and the interface to Si
- Conducting polymers
- High-Dk and low-Dk materials
- Bucky balls and carbon nanotubes
- Actuator materials
- Hybrid materials
- Materials for optoelectronics
- Contacts and barriers

12 12 06  Physical Microanalysis
Physikalische Mikroanalytik

EI  SMTL  W  2 0 1  4.5 cr
The goal of this course is to give an overview about the main microanalytical methods used in microelectronics for material and defect characterization based on electron and ion beam techniques. Starting with the physical fundamentals a detailed description of the following microanalytical methods will be given:
Analytical Electron and Ion Microscopy
Auger Electron and Photoelectron Spectroscopy
Secondary Ion Mass Spectroscopy
Rutherford Backscattering
Scanning Tunnel and Atomic Force Microscopy

examination: oral language: German
prerequisites: Intermediate examination, materials science II
lecturer: Bartha, Wenzel
12 12 07 Vacuum Technology
Vakuumtechnik

EI SMTL W 2 0 0 3 cr
Vacuum Technology plays a significant role in semiconductor manufacturing. Within this course the required basics for the understanding of the process related vacuum techniques will be taught. This includes gas kinetics, vacuum- and gas flow regions and measurement, vacuum generation and principles of pumping systems.

examination: oral language: German or English
prerequisites: Intermediate examination
lecturer: Bartha

12 12 08 Microelectronics Seminar for Graduate Students
Oberseminar Mikroelektronik

EI SMTL W 0 2 0 S 0 2 0 6 cr
The seminar covers actual topics from the field of Semiconductor- and Microsystems Technologies. Seminar presentations will be prepared by the students participating in the seminar.

examination: Seminar Presentation language: German or English
prerequisites: Intermediate examination
lecturer: Bartha, Fischer

12 12 09 Finite Elemente Method in Microelectronics
Finite Elemente Methode für Mikroelektroniker

EI SMTL W 2 0 0 3 cr
The course introduces to the Theory and Practise of Finite Element Method based on the needs of microelectronics industry. The following subjects are covered:

- Microelectronics needs: FEM simulation for improved manufacturability and reliability
- 3-D Mechanics: The genuine application field of FEM
- FEM for Discrete Systems: Stiffness matrix (of elements and systems)
- FEM for Continua: Shape Function – linear, quadratic, cubic, …,
- Nonlinearities (Newton-Raphson iteration schemes), Time dependencies (Euler / Crank-Nicolson methods)
- General fields (thermal, electrical) and Coupled-fields (thermal-mechan., piezo-electric, )
- Simulation strategies - based on commercial FEM codes: general methodology, scripting (parametric user macros), sub-modeling / sub-structuring techniques, user programmable features

examination: oral language: German or English
prerequisites: Intermediate examination
Lecturer: Rzepka
12 12 10  Microelectronics Seminar for Graduate Students
Oberseminar Mikroelektronik

EI  SMTL  S  0 2 0  3 cr
The seminar covers actual topics from the field of Semiconductor- and Microsystems Technologies. Seminar presentations will be prepared by the students participating in the seminar.

examination:  Seminar Presentation
prerequisites:  Intermediate examination
lecturer:  Bartha/Fischer

language:  German or English

12 12 11  Thin Films
Dünne Schichten

EI  SMTL  S  2 0 1  4.5 cr
The aim of this course is to provide knowledge about thin film properties and thin film deposition processes used in microelectronics. The strong and complex interaction between deposition process (parameter) and thin film properties became very important for the fabrication of highly integrated circuits. So, the functionality and reliability of thin film structures depends very strongly on the quality of the deposition process and requires in depth knowledge from the process designer.

The following deposition processes will be discussed in this manner:
- Chemical Vapor Deposition (LP-CVD, PE-CVD, ALD)
- Physical Vapor Deposition (Magnetron Sputtering, MBE, evaporation techniques)

examination:  oral
prerequisites:  Intermediate examination, materials science II
lecturer:  Bartha, Wenzel

language:  German

12 12 12  Microelectronics Technology
Mikroelektronik-Technologie

EI  SMTL  S  2 1 0  4.5 cr
The course covers several complex problems related to IC manufacturing process control and device reliability.

Content:
- Yield
- Reliability
- Electro migration
- Process Characterization
- Clean Room Technology
- Modern Process Technologies (CMP/ECD)
- Special Devices

examination:  oral
prerequisites:  Intermediate examination, semiconductor technology 1+2
lecturer:  Bartha, Melzer, Rzepka et al

language:  German or English
### 12 12 13 Design and Simulation of Microsystems

**Entwurf und Simulation von Mikrosystemen**

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<td><strong>The aim of this course is to provide knowledges of modelling, simulation and design of microsystems. The following topics will be covered:</strong> modellng and simulation of basic technology processes (ion implantation, diffusion, oxidation and etching), properties of micromechanical elements and devices, introduction to 1D-/2D technology and device simulators. The basics of modelling and simulation of multinature systems (electrical- and mechanical systems) and simulator coupling are imparted. The course introduces the fundamentals of microsystem design. Thereby the computer languages VHDL and VHDL-AMS are used to describe microsystems with electrical and non-electrical devices.</td>
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### 12 12 14 Characterization Techniques for Semiconductor- and Microtechnology

**Messtechnik für die Halbleiter- und Mikrotechnik**

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| **This part of the course covers fundamentals and application of semiconductor measurements with focuses on material, film and feature characterization. Topics are:**  
- resistivity  
- carrier properties obtained from electrical and optical measurements (doping and carrier concentration, mobility, lifetime)  
- properties of dopands and defects  
- investigations of semiconductor surfaces |
| examination: | oral (part 1 & 2 together) | language: | German |
| prerequisites: | Intermediate examination |
| lecturer: | Bartha, Fischer, Plötner |

### 12 12 15 Characterization Techniques for Semiconductor- and Microtechnology (2)

**Messtechnik für die Halbleiter- und Mikrotechnik (2)**

<table>
<thead>
<tr>
<th>EI</th>
<th>SMTL</th>
<th>S</th>
<th>201</th>
<th>4.5 cr</th>
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</thead>
</table>
| **This part of the course focuses on basic principles of thin film measurements and their adaption to micro technologies. Specific content is the measurement of**  
- geometrical parameters,  
- optical,  
- mechanical, and  
- electrical properties of thin films, relevant substrates and surfaces.  
An additional special point introduces PC-assisted data acquisition and device control. The practicals cover a comparative study of thickness measurements (2) and PC-DAQ (2). |
| examination: | oral (part 1 & 2 together) | language: | German |
| prerequisites: | Intermediate examination |
| lecturer: | Fischer/Plötner |
The aim of this course is to provide knowledge of modelling, simulation and design of microsystems. Beginning with an analysis of micromechanical elements, like mikrobeams or microplates and devices different kinds of appropriate models are introduced, e.g. as related concentrated electrical analog parts or Finite-Element models. The simulation methods of this multinature systems (electrical- and mechanical systems) and simulator coupling are imparted. Thereby the computer languages VHDL and VHDL-AMS are used to describe microsystems with electrical and non-electrical devices, too.

examination: oral
language: German
prerequisites: Physics, mathematics, microsystems technology
lecturer: Gerlach, Marschner

The lecture connects the advantages of network simulation of electromechanical systems with Finite Elements Modeling. This enables a design-oriented and hence more efficient optimization of the dynamic behavior of electromechanical systems. The lecture comprises the following chapters:
- Calculation of electromechanical networks using the circuit analysis tool PSPICE
- Modeling of mechanical subsystems with the finite elements simulation tool ANSYS
- Methodology of the combination of the procedures by means of virtual sub-elements
- Application examples: piezoelectric transducers, magnetic systems and ultrasonic transducers

examination: written and oral
language: German
prerequisites: electromechanical networks
lecturer: Pfeifer

The course presents techniques for the effective analysis of the dynamic properties of elementary mechanical and coupled mechanical-electrical systems using network methods. Translatory and rotatory mechanical systems as well as acoustical ones are modelled as networks. Their dynamic complex transfer function is calculated by means network theory methods. In particular both, the frequency and the dynamic response of mechanical resonance systems can be investigated with these methods. The coupling of electrical and mechanical networks treated is exemplified for electrodynamic transducers and the piezoelectric acceleration sensors.

examination: written
language: German
prerequisites: pre-degree in electrical engineering or mechatronics
lecturer: Pfeifer
The course offers problems of the electromechanical measurements, especially the error correction. A general model of measurement system with non-linearity effects, dynamic and stochastic disturbed elements is presented. Furthermore, the lecture is treating: measurements for calibration and control, transducer characterization (linearity, null balance, hysteresis, creep, noise level) and dynamic correction of sensors.

examination: oral  
prerequisites: electromechanical networks  
lecturer: Pfeifer

The aim of this practical course is the application of the topics dealt with in the lecture electromechanical networks. Therefore laboratories about
- the measurement of sound pressures and
- the determination of parameters of electrodynamical loudspeakers
will be carried out. In addition, aspects concerning the examination of measurement results, error discussion and the use of standards are treated.

examination: oral  
prerequisites: electromechanical networks  
lecturer: Pfeifer
Faculty of Science - Department of Mathematics
01 DM

00 01 01  Introduction to Analysis and Algebra
Algebraische und analytische Grundlagen

FS  DM  W  6  4  0  15 cr
This course introduces the fundamentals of analysis and algebra. The following topics are covered: sets, relations, combinatorics, real and complex numbers, linear algebra, analytical geometry, calculus for functions with one real variable.

examination: written
language: German

prerequisites: 

lecturer: Sasvári

00 01 02  Calculus for functions with several variables
Mehrdimensionale Differential- und Integralrechnung

FS  DM  S  4  4  0  12 cr
This course covers the following topics: calculus for real valued functions with several real variables, vector-analysis, infinite series, power series, Fourier series, ordinary differential equations.

language: German

prerequisites: Introduction to Analysis and Algebra

lecturer: Sasvári

00 01 03  Selected mathematical topics
Spezielle Kapitel der Mathematik

FS  DM  W  2  2  0  S  2  2  0  12 cr
This course gives an introduction to the following areas of mathematics: theory of functions of one complex variable, probability theory, partial differential equations.

language: German

examination: Written

prerequisites: Calculus for functions with several variables

lecturer: Sasvári
00 02 01  Physics
Physik

FS  DP  W  2 2 0  S  2 1 0  10.5 cr

Mechanics: Newton’s axioms, Conservative Laws, Oscillations, Gyration, Gravitation,
Accelerated frameworks, specific theory of relativity, Hydrostatic, Hydrodynamics
Thermodynamics: Kinetic theory of gases, I. und II. Fundamental theorem, Thermodynamic
phases, Phase transformations, Transport Processes

examination: written
prerequisites: German
lecturer: Blochwitz

00 02 02  Physics laboratory
Physikalisches Praktikum

FS  DP  W  0 0 2  3 cr

FA und FZ - error analysis, GS - coupled oscillations  LF - air humidity
RP - reversion-pendulum,  RF - viscosity  AZ -
DF - density  SR - tube flow  adiabatic change of state
OS - surface tension,  TA - thermal expansion  OA - optical imaging
DD - torsional vibration,  UE - conversion energy  MI - microscope
ST - impact  KA - specific heat  PO - polarisation

examination: German
prerequisites: physics, mathematics
lecturer: Escher

Department of Computer Science
03  CS_

00 03 01  Computer Science 1,2
Informatik1,2

EI  CL  W  2 1 0  S  2 0 1  9 cr

This two semester course introduces basic knowledge of the technical foundations of
computer science during the winter semester and gives an introduction into programming
during the summer semester. Topics of the winter semester are: number representation,
Boolean algebra, arithmetic units, control units, microprogrammed processor, RISC
processor, and pipelining.
The summer semester mainly deals with object oriented programming: Introduction to
object oriented programming, quality measures, inheritance, interfaces, exceptions, IO.
These topics are accompanied by a lab in which small groups of students have to develop a
full application. At the end of the semester alternative programming paradigms are
presented: functional programming and declarative programming.
Faculty of Mechanical Engineering
04 ME

00 04 01  Materials
Werkstoffe

ME MSL  S  2 1 0  4.5 cr

- Content is under construction.

examination: written  language: German
prerequisites:  None (minimal mathematical knowledge is presumed)
lecturer: Hochberger

00 04 02  Engineering Mechanics 1
Technische Mechanik 1

ME SML  S  2 1 0  4.5 cr

The course deals with rigid body statics and fundamentals of the strength of elastic bodies. Basic concepts: rigid body, concentrated loads (force, couple), cut principle, Cartesian frames of reference. Forces and couples in plane statics: equivalent loads, equilibrium, plane structures, internal loads of beams, plane assembled structures. Center of gravity: bodies, areas, lines. Strength of materials: elementary concepts, stress, strain, Hooke’s law, tension, compression, shear. Simple fields of stresses and strains: torsion of circular shafts, bending of beams with symmetric cross section, failure hypotheses, buckling of columns.
Exercises: solution of Problems.

examination: written  language: German
prerequisites: mathematics, physics, materials
lecturer: Balke, Ulbricht

00 04 03  Engineering Mechanics 2
Technische Mechanik 2

ME SML  S  1 1 0  3 cr
The course deals with the fundamentals of rigid body kinetics and continues the strength of elastic bodies.


Exercises: solution of Problems.

examination: written language: German
prerequisites: mathematics, physics, materials, engineering mechanics 1
lecturer: Ulbricht, Hellmann

00 04 04 Power plants
Kraftwerksanlagen

<table>
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<tr>
<th>ME</th>
<th>MPE</th>
<th>S</th>
<th>2</th>
<th>1</th>
<th>0</th>
<th>4.5 cr</th>
</tr>
</thead>
</table>

- Content is under construction.

examination: written language: German
prerequisites: mathematics, physics, materials, engineering mechanics 1
lecturer: Hiller

00 04 05 Mechanism-Engineering
Mechanismentechnik

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<tr>
<th>ME</th>
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<th>2</th>
<th>1</th>
<th>0</th>
<th>4.5 cr</th>
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This lecture deals with the following subjects:

Fundamentals: pairs, degree of freedom, constrained motion, kinematic chain, transmission angle, condition for complete rotation
Planar kinematics: planar motion, instantaneous centre of rotation, centrodes
Kinematic analysis: transmission equation, transmission function, velocity, acceleration
Applications: linkages, cam mechanisms, combined mechanisms.

examination: written language: German
prerequisites: mathematics, physics, mechanics
lecturer: Modler
00 05 01 Electric Railway Systems I
Elektrische Bahnen II

TTS S 2 1 0 4.5 cr

Basic knowledge about the complex system Electric Railway is taught.

Content:
- system requirements
- subsystems of electric railways and their interaction
- main components of electric locomotives
- main components of rail power supply systems
- basics of power dimensioning of electric railway systems

examination: oral language: German
prerequisites: pre-degree (intermediate diploma)
lecturer: Biesenack

00 05 02 Electric Railway Systems II
Elektrische Bahnen II

TTS S 2 1 0 4.5 cr

A selection of important design approaches and constraints of electric railways is presented and discussed.

Content:
- calculation of traction force and power of electric locomotives
- energy and power requirements of electric railways
- rail power supply operation management, especially at frequency of 16.7Hz
- voltage stability and voltage drops in rail contact lines
- contact line protection
- contact line interference (e.g. EMI) and rail power supply grounding schemes
- modelling of electric railway systems

examination: oral language: German
prerequisites: Electric Railway Systems I
lecturer: Biesenack

00 05 03 Design of Mechatronic Systems in Automotive Vehicles
Entwurf mechatronischer Systeme im Kraftfahrzeug

TTS W 2 0 0 3 cr

- Content is under construction.

examination: # language: German
prerequisites: #
lecturer: Bäker