Faculty of Electrical Engineering and Information Technology

Module Handbook

for the Master Program

Electrical Engineering and Information Technology

Version from 04. September 2024

Technical Note: The module names in the table of contents are linked to the module descriptions. You can return to the table of contents by clicking the link under each module description. Alternatively, you can navigate using the bookmark function of various PDF viewers.

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1 Compulsory Modules

1.1 Digital Communication Systems

English title	Digital Communication Systems
Qualification goals and contents of the module	**Learning objectives and acquired competences:** The Student will • gain knowledge about the functions and properties of digital communication systems. • understand the physical principles underlying digital communication. • gain knowledge about the modern wired and wireless digital communication standards. **Contents:** • Introduction • Signal representation • Stochastic processes and noise • Sampling, quantization, and coding • Transmission bandwidth, data rate, and channel capacity • Calculation of error rates • PCM, ASK, PSK, and FSK modulation techniques • OFDM and CDMA • Modeling of wireless channels
Literature	[1] Jerry D. Gibson: Principles of Digital and Analog Communications. Macmillian Publishing Company, 1989, ISBN 0-02-341780-3
Language	English
Forms of teaching	Lecture, Exercise
Requirements for participation	Bachelor in Electrical Engineering or related studies
Usability of the module	Compulsory module for the Master Course "Electrical Engineering and Information Technology".
Examinations prerequisite	None
Exam performance	Written exam 120 minutes at the end of the module
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 1 SWS Exercise Autonomous work: Post processing of lectures, solving of exercises, research report and preparation of exam
Availability	Every year in the summer semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr.-Ing. habil. Holger Maune (FEIT-IIKT)

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1.2 Digital Information Processing

English title	Digital Information Processing
Qualification goals and contents of the module	**Learning objectives and acquired competences:** • The participant has an overview of basic problems and methods of digital signal processing. • The participant understands the functionality of a digital signal processing system and can mathematically explain the modus of operation. • The participant can assess applications in terms of stability and other markers. He / She can calculate the frequency response and reconstruction of analogue signals. • The participant can perform these calculations and assessments as well on stochastically excited digital systems. • The participant can apply this knowledge in a field of specialization, e.g. Medical Signal Analysis. **Contents:** • Digital Signals and Digital LTI Systems • Z-Transform and Calculations of Inverse Z-Transforms • System Analysis by Difference Equations • Sampling and Reconstruction • Synthesis and analysis of such systems • Discrete and Fast Fourier Transformations • Processing of Stochastic Signals by LTI-Systems: Correlation Techniques and Model-Based Systems (ARMA). Selected Specialization Topics, e.g. Medical Signal Analysis
Literature	[1] Oppenheim, A; Schafer R (2013): "Discrete Time Signal Processing", 1056 pages, Pearson, ISBN: 978-1292025728 [2] Lathi, B P; Green, R A (2014) "Essentials of Digital Signal Processing", 748 pages, Cambridge University Press, ISBN: 978-1-107-05932-0
Language	English
Forms of teaching	Lecture, Exercise
Requirements for participation	Bachelor in Electrical Engineering or related studies Knowledge of signals and systems, Analog Fourier transformations
Usability of the module	Master Courses in the Faculty of Electrical Engineering and Information Technology, and other Master Courses.
Examinations prerequisite	Mandatory participation in exercise classes, successful results in exercises
Exam performance	Written exam 120 minutes at the end of the module
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 1 SWS Exercise Autonomous work: Post processing of lectures, solving of exercises and preparation of exam
Availability	Every year in the winter semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr. rer. nat. Andreas Wendemuth (FEIT-IIKT)

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1.3 Electromagnetic Field Theory

English title	Electromagnetic Field Theory
Qualification goals and contents of the module	**Learning objectives and acquired competences:** The Student • will know mathematical basics (vector analysis, operators and integral theorems). • know and understand fundamental laws of electromagnetics, constituting the system of Maxwell's field equations and the boundary conditions for the different fields. • learn how to solve basic problems for static and dynamic fields. **Contents:** • Mathematical fundamentals • Static electric fields • Stationary currents and the static magnetic field • Time-varying electromagnetic
Literature	[1] J.A. Edminster, Schaum's Outline of Electromagnetics - (Schaum's Outline Series), McGraw-Hill Book Company
Language	English
Forms of teaching	Lecture, Exercise
Requirements for participation	Bachelor in Electrical Engineering or related studies
Usability of the module	Compulsory module for the Master Course "Electrical Engineering and Information Technology".
Examinations prerequisite	None
Exam performance	Written exam 120 minutes at the end of the module
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 1 SWS Exercise Autonomous work: Post processing of lectures, solving of exercises and preparation of exam
Availability	Every year in the winter semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr.-Ing. Marco Leone (FEIT-IMT)

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1.4 Electronic Circuits

English title	Electronic Circuits
Qualification goals and contents of the module	**Learning objectives and acquired competences:** The Student will • understand the main function principles on the interface between analog and digital circuit design. • have an overview about the realization of some complex function blocks. **Contents:** • digital analog converters: methods, characteristics, errors, applications • analog digital converters: classification, methods, characteristics, errors, applications • phase locked loops: principle, linear model, circuit design of the function blocks, applications • characteristics, circuit design of some function blocks, design process, introduction VHDL • design and test of digital circuits with programmable logic devices
Literature	[1] U. Tietze, C. Schenk, D. Gamm: Electronic Circuits: Handbook for Design and Applications [2] Springer R. Best: Phase-Locked Loops: Design, Simulation and Applications
Language	English
Forms of teaching	Lecture, Exercise/Laboratory Internship
Requirements for participation	Bachelor in Electrical Engineering or related studies
Usability of the module	Compulsory module in the Master Course "Electrical Engineering and Information Technology".
Examinations prerequisites	None
Exam performance	Oral test at the end of the module
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 1 SWS Exercise/Laboratory Internship Autonomous work: Post processing of lectures, solving of exercises, laboratory work, research report and preparation of exam
Availability	Every year in the winter semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr.-Ing. Fabian Lurz (FEIT-IIKT)

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1.5 Power Electronics

English title	Power Electronics
Qualification goals and contents of the module	**Learning objectives and acquired competences:** Knowledge about important power electronic circuits shall be imparted. Major methods to understand power electronic circuits are practised. Applications will be demonstrated in the exercise. Cross-links to related fields of electrical and information engineering will be shown. **Contents:** • choppers, buck chopper, boost chopper, phase leg • self commutated bridges with constant voltage DC link, H-bridge, three phase bridge • rectifiers, single and three phase, uncontrolled, half controlled, controlled • AC controllers
Literature	[1] Ned Mohan: Power electronics - converters, applications and design; Wiley, Hoboken NJ, 3rd edition 2003
Language	English
Forms of teaching	Lecture, Exercise
Requirements for participation	Bachelor in Electrical Engineering or related studies, comprising, fundamentals of electrical engineering, electronics – circuit theory, fundamentals of semiconductor components, mathematics
Usability of the module	Compulsory module for the Master Course "Electrical Engineering and Information Technology" belonging to the field of electrical.
Examinations prerequisite	None
Exam performance	Written exam 120 minutes without auxiliaries at the end of the module
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 1 SWS Exercise Autonomous work: Post processing of lectures, solving of exercises and preparation of exam
Availability	Every year in the winter semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr.-Ing. Andreas Lindemann (FEIT-IESY)

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1.6 Power Network Planning (and Operation) (Applies as described here Deviating from sSPO M-EEIT)

English title	Power Network Planning (and Operation)
Qualification goals and contents of the module	**Learning objectives and acquired competences:** The student will learn about steady-state and quasi-stationary algorithms to model and calculate grid states for the purpose of power system planning and operation. This includes the modelling of topology and equipment in natural and modal components, power flow calculation, state estimation, stability and short-circuit calculations as well as modelling of shunt and series faults. **Contents:** • Introduction to the tasks of network planning and system operation • Equation systems to describe steady-state and quasi-steady-state problems in electric power networks • Grid modeling using modal component systems • Basic algorithms of power flow, short-circuit and stability calculations as well as state estimation • Introduction to power grid modelling with MATLAB
Literature	[1] Electric Power System Planning", H. Seifi, M.S. Sepasian, Springer-Verlag, 2011 [2] „Power system engineering : planning, design, and operation of power systems and equipment", Juergen Schlabbach. - Weinheim : WILEY-VCH, 2008
Language	English
Forms of teaching	Lecture, Exercise
Requirements for participation	Bachelor in Electrical Engineering or related studies
Usability of the module	Compulsory module for the Master Course "Electrical Engineering and Information Technology".
Examinations prerequisite	None
Exam performance	Written exam 90 minutes at the end of the module
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 1 SWS Exercise Autonomous work: Post processing of lectures, solving of exercises and preparation of exam
Availability	Every year in the winter semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr.-Ing. habil. Martin Wolter (FEIT-IESY)

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1.7 Project

English title	Project
Qualification goals and contents of the module	**Learning objectives and acquired competences:** • The student knows the typical processes and techniques of scientific work. After passing the module, the student is able to analyze the current state of science and technology and to develop own scientific project ideas. The student can perform a market analysis, develop project specifications and write a scientific project report. • The student knows the basic rules of scientific writing. After completing the module, the student is able to structure a report or thesis, to create significant plots and figures, and to cite all used sources. The student is very well aware of the problem of plagiarism. The student is also able to defend his project results in an oral presentation. **Contents:** **Part 1 (Non-technical Project Seminar)** The seminar consists of four lectures with the topics • Literature survey and reference management • Rules of scientific writing, Visualization, schematics and diagrams • Effective oral presentations,writing a short paper (1 page) and giving a short presentation (5 minutes) about a given topic **Part 2 (Non-technical Project Work)** • Application of the obtained skills on a specific topic under supervision of the project supervisor **Schedule** Lecture Week — Event 01 to 04 — Lectures of part 05 — Short paper submission/review of part 1 06 — Short presentations of part 1, issue of the certificates of attendance of part 1 07 to 14 — Part 2
Literature	[1] R. C. Dorf, R. H. Bishop: Modern Control Systems, Pearson Education, 2005
Language	English
Forms of teaching	Research project
Requirements for participation	Part 2 of the module can only be attended if the part 1 was successfully passed
Usability of the module	Compulsory module for the Master's course "Electrical Engineering and Information Technology".
Examinations prerequisite	None
Exam performance	Research project (PRO)
Credit points and grades	5 CP = 150 h Grading scale as per examination regulations
Work effort	The first part of the module is accounted with 12 hours of attendance and 8 hours of autonomous work. The remaining time for the second part of the module is then 30 hours of attendance and 100 hours of autonomous work.
Availability	Every year in the summer semester
Duration of the module	One Semester
Responsible lecturer	Dr.-Ing. Magdowski (FEIT-IMT) in conjunction with work supervisor

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1.8 Systems and Control

English title	Systems and Control
Qualification goals and contents of the module	**Learning objectives and acquired competences:** The student will learn how to • mathematically describe and analyses dynamic systems. • design feedback control systems using frequency and time domain techniques. • efficiently apply modern software tools to achieve the aforementioned goals. **Contents:** • Introduction to control systems • Mathematical models of systems • Feedback control systems characteristics • The performance of feedback control systems • The stability of linear feedback systems • The root locus method • Frequency response method • The design of state variable feedback systems (Full-state feedback design and observer design methods)
Literature	[1] R. C. Dorf, R. H. Bishop: Modern Control Systems, Pearson Education, 2005
Language	English
Forms of teaching	Lecture, Exercise
Requirements for participation	Bachelor in Electrical Engineering or related studies
Usability of the module	Compulsory module for the Master's course "Electrical Engineering and Information Technology", optional module for students of the "International Max-Planck Research School" and the Master's course "Chemical Process Engineering".
Examinations prerequisite	None
Exam performance	Written exam 120 minutes at the end of the module
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 1 SWS Exercise Autonomous work: Post processing of lectures, solving of exercises and preparation of exam
Availability	Every year in the winter semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr.-Ing. habil. Achim Kienle (FEIT-IFAT)

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2 Technical Elective Modules

2.1 Field of Study Automation Systems

2.1.1 Automation Lab

English title	Automation Lab
Qualification goals and contents of the module	**Learning objectives and acquired competences:** To develop practical skills in the field of (process) automation. **Contents:** The acquired knowledge from the courses "Systems and Control" and "Distributed Control Systems" should be applied to practical examples/systems of automation. For these purposes miscellaneous experiments will be conducted.
Literature	According to modules "Systems and Control" and "Distributed Control Systems"
Language	English
Forms of teaching	Laboratory Internship
Requirements for participation	Bachelor in Electrical Engineering or related studies, Systems and Control, Distributed Control Systems
Usability of the module	Compulsory elective module for the Master Course "Electrical Engineering and Information Technology".
Examinations prerequisite	None
Exam performance	Oral test after every experiment
Credit points and grades	2 SWS / 5 CP = 150 h (28 h time of attendance + 122 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Laboratory Internship Autonomous work: Post processing and preparation of Laboratory Internship
Availability	Every year in the winter semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr.-Ing. habil. Achim Kienle (FEIT-IFAT)

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2.1.2 Digital Automation Systems

English title	Digital Automation Systems
Qualification goals and contents of the module	**Learning objectives and acquired competences:** At the end of the course, the students will have core competencies in the designand construction of distributed digital automation systems. They will understand how to plan and implement the integration of various automation componentsand which automation and information technologies are used. Students acquire the ability to recognize and interpret abstract automation and information technology models and to grasp their interrelations in order to create functional automation systems. Through the exercises, the students are able to deepen their knowledge and skills in a research-oriented way and to apply and evaluate them in complex problems. **Contents:** • Models and methods for handling automation systems • Information models • Integration technologies • Principles of descriptive description methods for technical systems
Literature	[1] Wolfgang Mahnke, Stefan-Helmut Leitner, Matthias Damm: OPC Unified Architecture. Springer-Verlag Berlin Heidelberg 2009. ISBN 978-3-540-68898-3, DOI 10.1007/978-3-540-68899-0, e-ISBN 978-3-540-68899-0 [2] Riedl, M., Naumann, F.: EDDL. Vulkan-Verlag. ISBN-10: 3835632434. Standard books UML and XML.
Language	English
Forms of teaching	Lecture, Exercise
Requirements for participation	Bachelor in Electrical Engineering, Computer Science or related studies
Usability of the module	Compulsory elective module for the Master Course "Electrical Engineering and Information Technology" and "Digital Engineering".
Examinations prerequisite	None
Exam performance	Written exam 90 minutes at the end of the module
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 1 SWS Exercise Autonomous work: Post processing of lectures, solving of exercises, preparation of presentation and exam
Availability	Every year in the winter semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr.-Ing. Christian Diedrich (FEIT-IFAT)

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2.1.3 Non-linear Control

English title	Non-linear Control
Qualification goals and contents of the module	**Learning objectives and acquired competences:** The students will be able to describe and model nonlinear systems, to analyze the system dynamic behaviour such as stability considering different stability concepts, and to design controllers for nonlinear systems. **Contents:** • Review of mathematical basics • Review of linear MIMO systems • Lyapunov stability • Concepts of BIBO stability • Passivity • I/O linerarization • Design of controllers for nonlinear systems
Literature	[1] D.E. Kirk. Optimal Control Theory – An Introduction. Prentice-Hall Inc., Englewood Cliffs, New Jersey, 2004 [2] D.P. Bertsekas. Dynamic Programming and Optimal Control, volume 1. Athena Scientific Press, Belmont, MA, 2006 [3] R. Bellman. Dynamic Programming. Princeton University Press, Princeton, New Jersey, 1957
Language	English
Forms of teaching	Lecture, Exercise/Tutorial
Requirements for participation	Knowledge in control theory
Usability of the module	Compulsory elective module for the Master Courses "Systemtechnik und Technische Kybernetik". Compulsory elective module for the Master Course "Electrical Engineering and Information Technology".
Examinations prerequisite	None
Exam performance	Oral test at the end of the module and project report
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	time of attendance: 2 SWS Lecture, 1 SWS Exercise/Tutorial autonomous work: Post processing of lectures, preparation of project work/report and exam
Availability	Every year in the summer semester
Duration of the module	One Semester
Responsible lecturer	PD Dr. sc. techn. ETH Eric Bullinger (FEIT-IFAT)

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2.1.4 Optimal Control / Predictive Control

English title	Optimal Control / Predictive Control
Qualification goals and contents of the module	**Learning objectives and acquired competences:** The module introduces the formulation, theory, solution and application of optimal control theory/dynamic optimization. The students are enabled to formulate and solve optimal control problems appearing in many applications spanning from engineering, process control up to medicine and systems biology. The students will be able to formulate optimal control problems on standard form from specifications on dynamics, constraints and control objective as well as to explain how various control objectives affect the optimal performance. They will be able to use the methods developed in the course to design open and closed loop controllers for optimal control problems. **Contents:** • Static optimization • Numerical algorithms • Dynamic programming, principle of optimality, Hamilton-Jacobi-Bellmann equation • Variational calculus • Pontryagin maximum principle • Numerical solution of optimal control problems • Infinite and finite horizon optimal control, LQ optimal control • Model predictive control • Game theory • Application examples from various fields such as chemical engineering, economics, aeronautics, robotics, biomedicine and systems biology
Literature	[1] R. Bellman. Dynamic Programming. Princeton University Press, Princeton, New Jersey, 1957. [2] D.P. Bertsekas. Dynamic Programming and Optimal Control, volume 1. Athena Scientific Press, Belmont, MA, 2006. [3] D.E. Kirk. Optimal Control Theory – An Introduction. Prentice-Hall Inc., Englewood Cliffs, New Jersey, 2004.
Language	English
Forms of teaching	Lecture, Exercise
Requirements for participation	Recommended: Control theory (frequency domain and state space approaches)
Usability of the module	Compulsory elective module for the Master Course EEIT, and other Master Courses. Compulsory module in other Master Courses of the OvGU.
Examinations prerequisite	None
Exam performance	Written exam 120 minutes at the end of the module
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 1 SWS Exercise Autonomous work: Post processing of lectures, solving of exercises, preparation of exam
Availability	Every year in the winter semester
Duration of the module	One Semester
Responsible lecturer	N.N. (FEIT-IFAT) Further lecturers: Priv.-Doz. Dr. sc. techn. ETH Eric Bullinger (FEIT-IFAT)

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2.1.5 Process Control

English title	Process Control

Qualification goals and contents of the module	**Learning objectives and acquired competences:**
	Students should
	• learn fundamentals of multivariable process control with special emphasis on decentralized control
	• gain the ability to apply the above mentioned methods for the control of single and multi unit processes
	• gain the ability to apply advanced software (MATLAB) for computeraided control system design
	
	Contents:
	1. Introduction
	2. Process control fundamentals
	  • Mathematical models of processes
	  • Control structures
	  • Decentralized control and Relative gain analysis
	  • Tuning of decentralized controllers
	  • Control implementation issues
	3. Case studies
	4. Plantwide control

Literature	[1] B. W. Bequette: Process Control, Modeling Design and Simulation, Pearson Education, 2003
Language	English
Forms of teaching	Lecture, Exercise/Tutorial
Requirements for participation	Basic knowledge in control theory
Usability of the module	Compulsory module for the Master Course “Elektrotechnik und Informationstechnik” Option “Automatisierungstechnik”. Optional module for the Master Courses “Systemtechnik und Technische Kybernetik” and “Chemical Process Engineering”, for students of the International Max-Planck Research School. Compulsory elective module for the Master Course “Electrical Engineering and Information Technology”.
Examinations prerequisite	None
Exam performance	Oral test at the end of the module and project report
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 1 SWS Exercise/Tutorial Autonomous work: Post processing of lectures, preparation of project work/report and exam
Availability	Every year in the summer semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr.-Ing. habil. Achim Kienle (FEIT-IFAT)

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2.1.6 State Estimation

English title	State Estimation
Qualification goals and contents of the module	**Learning objectives and acquired competences:** The module provides an introduction to state estimation and model based measurement systems. The students are enabled to judge whether the available measurement data are sufficient to reconstruct all states of a process model, or which additional measurement information is required. At the end of the course the students are able to choose suitable state estimation techniques for linear and nonlinear systems. Special emphasis is on the Kalman filter. The students are enabled to derive the filter equations, to implement them and to choose the tuning parameters. The acquired knowledge is deepened in computer exercises. In mini-projects, the students obtain practical experience in programming and testing state estimation algorithms. **Contents:** • Observability criteria for LTI systems • Luenberger observers for LTI systems with one or several measurements • Kalman filter for linear time-discrete systems • Kalman filter for linear time-continuous systems • Extended Kalman filter for nonlinear time-discrete and time-continous systems • Unscented Kalman filter • Kalman filter with constrained filter update • Bayesian estimators • Outlook on observers for nonlinear systems
Literature	[1] A. Gelb, Applied Optimal Estimation, M.I.T. Press, 1974. [2] D. Luenberger, Introduction to Dynamic Systems. Wiley, 1979. [3] D. Simon, Optimal State Estimation, John Wiley, 2006.
Language	English
Forms of teaching	Lecture, Exercise
Requirements for participation	Basic subjects of the bachelor's degree
Usability of the module	Compulsory elective module for various master's degree programs at the OvGU and for students of the International Max Planck Research School
Examinations prerequisite	None
Exam performance	Written exam 90 minutes at the end of the module
Credit points and grades	4 SWS / 5 CP = 150 h (56 h time of attendance + 94 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 2 SWS Exercise Autonomous work: Following up on lectures, solving exercises/project tasks, preparing for the exam
Availability	Every year in the summer semester
Duration of the module	One Semester
Responsible lecturer	Dr.-Ing. Christian Kunde (FEIT-IFAT)

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2.2 Field of Study Information and Communication Technology

2.2.1 Automatic Speech Recognition Systems

English title	Automatic Speech Recognition Systems
Qualification goals and contents of the module	**Learning objectives and acquired competences:** • The participant understands basic problems and methods of automatic speech recognition with Hidden Markov Models. • The participant understands the functionality of the relevant computer modules in speech recognition and can mathematically explain the modus of operation. • The participant knows specific requirements for speech recognition. These can include reliability, availability, speaker verification. • The participant knows specific requirements and differences in command, dictation and dialogue mode, particularly in the field of applications (e.g. medical) and support systems. **Contents:** • Production and Reception of Natural Speech • Feature Extraction • Classification Techniques • Hidden Markov Models (DTW, Viterbi, Baum-Welch) • Language Models • Aspects of robust Speech Recognition: adaptivity, reliability, availabilty, speaker verification. • Practical Speech Recognition Systems Design
Literature	[1] Rabiner, L & Juang, B (1993): „Fundamentals of Speech Recognition“, 507 pages, Prentice Hall, ISBN: 0-13-015157-2
Language	English
Forms of teaching	Lecture, Exercise, Laboratory Internship
Requirements for participation	Bachelor in Electrical Engineering or related studies Knowledge of Digital Signal Processing
Usability of the module	Compulsory elective module for the Master Course “Electrical Engineering and Information Technology”.
Examinations prerequisite	Mandatory participation in exercise classes, successful results in exercises
Exam performance	Written exam 90 minutes at the end of the module
Credit points and grades	4 SWS / 5 CP = 150 h (56 h time of attendance + 94 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 1 SWS Exercise, 1 SWS Laboratory Internship Autonomous work: Post processing of lectures, preparation of exercises and exam
Availability	Every year in the summer semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr. rer. nat. Andreas Wendemuth (FEIT-IIKT)

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2.2.2 Chatbot-Challenge

English title	Chatbot-Challenge
Qualification goals and contents of the module	**Learning objectives and acquired competences:** • Creation of chatbot systems with the Rasa Framework. • Training, evaluation and direct application of AI models of Natural Language Understanding. • Experience in collecting and preparing training data for classification (required amount of data, data balance in different classes). • Creating consistent answers and help texts that contribute to better usability and game design • Evaluation of trained models with regard to their classification performance (suitable measures, cross-validation). • Creation of a chatbot for a selected practical example. • UX user tests (planning, selection of suitable survey tools, implementation and evaluation and derivation of measures for your own chatbot). • Experience with project management and milestone presentations. **Contents:** The task is to develop an escape room game using the AI-supported chatbot framework Rasa. In an escape room, players have to solve a series of puzzles in order to free themselves from a room. The result of the module should be an operable chatbot with a playable and consistent story. This should be proven through user tests. However, the focus here is primarily on the holistic creation of an AI project, from the idea to implementation and evaluation in "productive use". In addition to the pure recognition rate, user experience (UX) and game experience are also important metrics for evaluating the chatbot in the challenge. Not only the generation of the AI model is to be learned, which enables the chatbot to interpret inputs in natural language semantically correctly, but also how the UX of an interactive dialogue system can be evaluated. The study project therefore establishes the extremely relevant link between the creation of an AI-supported system and its use by and impact on users. Within the module, students will present their progress via milestone talks, also in front of external experts, and submit a project report at the end.
Literature	
Language	German/English
Forms of teaching	Lecture, Seminar, Practical Exercises
Requirements for participation	Basic knowledge of Python
Usability of the module	Compulsory elective module for the Master Course "Electrical Engineering and Information Technology" and other FEIT and FIN Master Courses.
Examinations prerequisite	Presentations on the defined milestones, user tests
Exam performance	Presentations at the milestone meetings (4x10%) Written elaboration (project report) (60%)
Credit points and grades	4 SWS / 10 CP = 300 h (56 h time of attendance + 244 h autonomous work) Grading scale as per examination regulations

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Work effort	Time of attendance: 2 SWS Lecture, 2 SWS Seminar Autonomous work: Rework of lectures, working of the seminar task and practical exercises, preparation of the project report
Availability	In the summer semester 2025
Duration of the module	One Semester
Responsible lecturer	Jun.-Prof. Dr.-Ing. Ingo Siegert (FEIT-IIKT)

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2.2.3 Computed Tomography I - Methods on CT

English title	Computed Tomography I - Methods on CT
Qualification goals and contents of the module	**Learning objectives and acquired competences:** The student will • understand the system theory of imaging systems. • learn the functional principle of the computed tomography. • understand the mathematical principle of tomographic reconstruction. • have an overview about the current research work in the area of tomographic imaging. **Contents:** Starting with the system theory of imaging systems, the first part of the module is focused on the physical properties of x-rays and their interaction with matter. The second part deals with X-ray based standard radiography. The third and final part brings the mathematical methods of tomographic image reconstruction into focus. The particular content is: • System theory of imaging systems • Basic principle of underlying physics • X-ray tubes and detectors • Radiography • Reconstruction: Fourier-based principle, Filtered back projection, Algebraic approach, statistical methods • Beam-geometry: Parallel-, Fan- and Cone beam • Implementation • Artefacts and Adjustment
Literature	[1] Kak, Slaney: Principles of computerized tomographic imaging; Kalender: Computed Tomography
Language	English
Forms of teaching	Lecture, Tutorial
Requirements for participation	None
Usability of the module	Master Courses in the Faculty of Electrical Engineering and Information Technology, and other Master Courses.
Examinations prerequisite	Tutorial certificate
Exam performance	Written exam 60 minutes at the end of the module
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 1 SWS Tutorial Autonomous work: Rework of lectures and tutorials, preparation of exercises and exam
Availability	Every year in the winter semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr. rer. nat. Georg Rose (FEIT-IMT)

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2.2.4 Digital Information Processing Laboratory

English title	Digital Information Processing Laboratory
Qualification goals and contents of the module	**Learning objectives and acquired competences:** • The participant has an overview of basic methods of applied digital signal processing. • The participant can transform physiological knowledge into technical digital signal processing methods. • Selected Feature Space transformations and their applications are known. • Gaussian Production System Architectures are being estimated under Maximum-Likelihood Assumptions **Contents:** • Digital Signals and Digital LTI Systems • Synthesis and analysis of such systems • Selected Digital Filters • Discrete and Fast Fourier Transformations • Selected Feature Space transformations • Gaussian Production System Architectures Characteristics of Human Speech
Literature	[1] Oppenheim, A; Schafer R (2013): "Discrete Time Signal Processing", 1056 pages, Pearson, ISBN: 978-1292025728 [2] Lathi, B P; Green, R A (2014) "Essentials of Digital Signal Processing", 748 pages, Cambridge University Press, ISBN: 978-1-107-05932-0
Language	English
Forms of teaching	Seminar, Laboratory Internship
Requirements for participation	Credits obtained in the module „Digital Information Processing" (Prof. Wendemuth)
Usability of the module	Master Courses in the Faculty of Electrical Engineering and Information Technology, and other Master Courses.
Examinations prerequisite	Successful laboratory attendance (Praktikumsschein), and grading based on the average of the four best graded laboratory reports.
Exam performance	Oral test at the end of the module
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 3 SWS Seminar + Laboratory Internship Autonomous work: Pre- and post processing of course, preparation of exam
Availability	Every year in the summer semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr. rer. nat. Andreas Wendemuth (FEIT-IIKT)

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2.2.5 Heterogeneous Computing

English title	Heterogeneous Computing
Qualification goals and contents of the module	**Learning objectives and acquired competences:** After successfully completing the module, students will be able to discuss the computing principles of different hardware platforms and select a suitable computing principle for a given application. They can create applications that can be implemented on different hardware platforms and exploit their individual properties. Students can also transform algorithms in such a way that they make optimal use of the possibilities of a given hardware. The students can analyze the data flow within neural networks and adapt hardware architectures to their specifics. Through theoretical and practical exercises, students will be able to deepen their knowledge and skills in a research-oriented manner. Students will realize algorithms in OpenCL for GPUs and CPUs as well as gain practical experience in creating data flow descriptions for FPGA hardware accelerators. **Contents:** • Alternative computing principles • Design of hybrid computing systems • Dataflow computing • Introduction to OpenCL • Hardware based OpenCL programming for GPUs, FPGAs, and CPUs • Hardware architecture of GPUs • Introduction to Deep Neural Networks (DNN) • Hardware accelerators for DNNs • Hardware architecture of TPUs
Literature	
Language	English
Forms of teaching	Lecture, Exercise
Requirements for participation	Bachelor in electrical engineering or computer science, basic knowledge in C and C++
Usability of the module	Master Courses in the Faculty of Electrical Engineering and Information Technology, and other Master Courses.
Examinations prerequisite	None
Exam performance	Oral test at the end of the module
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 1 SWS Exercise Autonomous work: Post processing of lectures, solving of exercises and preparation of exam
Availability	Every year in the summer semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr.-Ing. Thilo Pionteck (FEIT-IIKT)

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2.2.6 Image Coding

English title	Image Coding
Qualification goals and contents of the module	**Learning objectives and acquired competences:** Learn about methods and techniques of image coding as essential part of image communication. Problems of image acquisition are treated as far as they are relevant for image coding. **Contents:** • Fundamentals • Basics of human perception • TV Systems • Basics of information • Quantisation • Lossless Coding • Lossy Coding • DPCM • Interframe Prediction • Transform Coding • Content based and semantic Coding • Standards and applications
Literature	[1] John W. Woods: Multidimensional signal, image, and video processing and coding, Academic Press, 2012
Language	English
Forms of teaching	Lecture, Exercise
Requirements for participation	Bachelor in Electrical Engineering or related studies
Usability of the module	Compulsory elective module for the Master Course "Electrical Engineering and Information Technology".
Examinations prerequisite	None
Exam performance	Oral test at the end of the module
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 1 SWS Exercise Autonomous work: Post processing of lectures, solving of exercises, preparation of presentation and exam
Availability	Every year in the winter semester
Duration of the module	One Semester
Responsible lecturer	Dr.-Ing. Gerald Krell (FEIT-IIKT)

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2.2.7 Microwave Engineering

English title	Microwave Engineering
Qualification goals and contents of the module	**Learning objectives and acquired competences:** At the end of the module, students will have a basic understanding of the e various areas of high-frequency design. They will have mastered the mathematical basics for the description of electromagnetic waves, esp. on transmission lines. They are familiar with the analysis of high-frequency circuits and can describe them using scattering parameters. They can design matching circuits in the Smith Chart. **Contents:** • Maxwell's equations and material equations • Transmission lines and wave propagation • Impedance transformation and Smith chart • Analysis of high-frequency circuits • Scattering parameters
Literature	See lecture notes
Language	English
Forms of teaching	Lecture, Exercise
Requirements for participation	Electromagnetic Field Theory, Digital Communication Systems
Usability of the module	Master Courses in the Faculty of Electrical Engineering and Information Technology, and other Master Courses.
Examinations prerequisite	None
Exam performance	Written exam 90 minutes at the end of the module
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 1 SWS Exercise Autonomous work: Post processing of lectures, solving of exercises, and preparation of exam
Availability	Every year in the summer semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr.-Ing. habil. Holger Maune (FEIT-IIKT)

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2.2.8 Microwave Measurement Techniques (µWMT) / Mikrowellenmesstechnik

English title	Microwave Measurement Techniques (µWMT)
Qualification goals and contents of the module	**Learning objectives and acquired competences:** Students should understand the principles of microwave metrology and be able to be able to apply them independently to measurement problems in the framework of communications and medical engineering. The following Fine Learning Objectives are associated with the lecture: • Students will understand the basic principles of power measurement and effects of mismatch or pulsed signals and can independently perform and interpret measurements. • Students will understand the fundamentals of spectrum analysis and will be able to perform and interpret measurements independently. • Students understand the fundamentals of scattering parameter measurement and calibration of network analyzers and are able to perform and interpret perform and interpret measurements. • The students know different methods for material characterization • The students work can solve measurements task such as characterization of biomedical materials or matching of MRI coils. **Contents:** Introduction to measurement techniques, high frequency components and their characteristics,RF power measurement, spectrum analysis, vector network analysis (scattering parameter, X-parameters, calibration), on-wafer metrology, load/source pull, high frequency characterization of materials.
Literature	Lecture notes, further literature is listed in the lecture notes
Language	English
Forms of teaching	Lecture, Exercise, Practical Excercise
Language	English or German
Requirements for participation	Recommended: Fundamentals of Communication Technology, Fundamentals of High Frequency Technology (previously: High Frequency Technology I)
Usability of the module	Compulsory elective module in the master's degree programs as well as other courses of study at FEIT.
Examinations prerequisite	None
Exam performance	Oral test at the end of the module
Credit points and grades	4 SWS / 6 CP = 180 h (56 h time of attendance + 124 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 1 SWS Exercice, 1 SWS Practical Exercise Autonomous work: Preparation and wrap-up of the lecture, the exercises, and preparation for exams
Availability	Every year in the winter semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr. habil. Holger Maune (FEIT-IIKT)

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2.2.9 Seminar „System-on-Chip“

English title	Seminar „System-on-Chip“
Qualification goals and contents of the module	**Learning objectives and acquired competences:** A system-on-chip (SoC) combines all aspects of a system on a single chip. It is a central component of many mobile computing devices as well as of modern embedded systems. Consequently, the design of SoCs poses many interesting questions, such as the management of heterogeneous processing units, the communication through an on-chip network or the application in critical systems. In this seminar the students work collaboratively to acquire an overview of the state of the art for one of these topics. Through this seminar the students will be able to independently search, understand and classify scientific literature. They will be able to present the acquired knowledge in a systematic way. Furthermore, they get a profound insight on current research topics in the field of system-on-chips. **Contents:** • Overview of a selected research topic connected to SoCs • How to read scientific papers • How to do a systematic literature search • Developing research questions based on the current state of the art
Literature	
Language	English
Forms of teaching	Seminar
Requirements for participation	Participation in the lecture “System on Chip” is recommended.
Usability of the module	Compulsory elective module in the option “Information and Communication Technology” of the master’s programs of the FEIT and further courses of studies at OvGU.
Examinations prerequisite	Active on-site participation in the seminar
Exam performance	Presentation
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 3 SWS Seminar Autonomous work: Reading assignments, preparation of talks
Availability	Every year in the winter semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr.-Ing. Thilo Pionteck (FEIT-IIKT)

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2.2.10 System-on-Chip

English title	System-on-Chip
Qualification goals and contents of the module	**Learning objectives and acquired competences:** A system-on-chip (SoC) combines all components of an electronic system on a single chip. This module deals with the basic structure of SoCs, the hardware architecture of the individual components and the effects of design decisions on the chip design. One focus of the lecture is on the design of the internal communication networker. After successful completion of the module, students will be able to independently define the basic structure of application-specific SoCs and to identify and evaluate design alternatives. Students will be able to describe standards and criteria for the design and use of SoCs and place them in the overall context. They can model problems and carry out a systematic design space exploration. They are able to select and parameterize suitable optimization methods. Through theoretical and practical exercises, students are able to deepen their knowledge and skills in a research-oriented manner. The characteristics of different communication architectures are clarified with the help of simulation tools. **Contents:** • Structure of system-on-chips (SoCs) • ARM processors • Bus architectures and bus standards • Network-on-chips (NoCs) • (heterogeneous) 3D chips • design space exploration • optimization techniques
Literature	
Language	English
Forms of teaching	Lecture, Exercise
Requirements for participation	Bachelor in electrical engineering or computer science, basic knowledge in C and C++
Usability of the module	Compulsory elective module in the Master Course "Electrical Engineering and Information Technology". Compulsory module in other master's degree programs at FEIT.
Examinations prerequisite	None
Exam performance	Oral test at the end of the module
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 1 SWS Exercise Autonomous work: Post processing of lectures, solving of exercises and preparation of exam
Availability	Every year in the winter semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr.-Ing. Thilo Pionteck (FEIT-IIKT)

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2.2.11 Theoretical Neuroscience II

English rule	Theoretical Neuroscience II
Qualification goals and contents of the module	**Learning objectives and acquired competences:** Based on Chapters 7-10 of Dayan und Abbott. Rate models of network dynamics, synaptic plasticity, reinforcement learning, and generative models. Linear models of neural networks, dynamic analysis of state-space, eigenvalue analysis of steady-states, models of activity-dependent plasticity, associative learning with neural networks, modern theories of reinforcement learning (Rescorla-Wagner, temporal-difference, actor-critic models), and abstract approaches to representational learning and generative models (expectation maximization, principal components, independent components). To develop a deeper understanding and to acquire applied and practical skills, students perform weekly homework assignments with Matlab programming. A passing grade on all assignments is required for admission to the final exam. The tutorial is open to all students and provides an opportunity for more extensive questions and discussions of the lecture material. It is particularly recommended for students with a weaker background in mathematics and physics.
Literature	[1] Dayan and Abbott (2001) Theoretical Neuroscience, MIT Press
Language	English
Forms of teaching	Lecture, Exercise
Requirements for participation	Required: basic knowledge in Calculus and Linear Algebra Useful: basic knowledge in programming
Usability of the module	Master Courses in the Faculty of Electrical Engineering and Information Technology, and other Master Courses.
Examinations prerequisite	None
Exam performance	Oral test at the end of the module
Credit points and grades	5 SWS / 5 CP = 150 h (70 h time of attendance + 80 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 3 SWS Lecture, 2 SWS Exercise Autonomous work: Post processing of lectures, solving of exercises, project work and preparation of exam
Availability	Every year in the summer semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr. Jochen Braun (FNW-IBIO)

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2.3 Field of Study Microsystems

The option "Microsystems" is not offered at the moment.

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2.4 Field of Study Power and Energy

2.4.1 Control of AC Drives (Regelung von Drehstrommaschinen)

English title	Control of AC Drives
Qualification goals and contents of the module	**Learning objectives and acquired competences:** The students will get knowledge about the dynamic models of the usual AC electric machines and the space vector representation. They will be able to understand the algorithms for the control of AC drives and to adjust their parameters. They will also be capable to asses advantages and drawback of the different machine types and control algorithms depending on a given application. **Contents:** • Optimization of control loops • The inverter as an power electronic actuator • Space vector representation • Model of the permanent magnet synchronous machine (PMSM) • Field oriented control of the PMSM • Model of the Induction machine (IM) • Field oriented control of the IM • Direct torque control (DTC)
Literature	[1] De Doncker et.al.: Advanced Electrical Drives, Analysis, Modeling, Control. Springer Science+Business Media B.V. 2011 [2] Mukhtar Ahmad: High Performance AC Drives, Modelling Analysis and Control. Springer-Verlag 2010
Language	English
Forms of teaching	Lecture, Exercise
Requirements for participation	Knowledge of Control Systems and Power Electronics
Usability of the module	Compulsory module for the Master Courses ETIT-EE and EE-RE. Compulsory elective module for the Master Courses EEIT, ETIT, MTK and STK.
Examinations prerequisite	None
Exam performance	Written exam 90 minutes at the end of the module
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 1 SWS Exercise Autonomous work: Post processing of lectures, preparation of project report and exam
Availability	Every year in the winter semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr.-Ing. Roberto Leidhold (FEIT-IESY)

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2.4.2 Digital Protection of Power Networks

English title	Digital Protection of Power Networks

Qualification goals and contents of the module	**Learning objectives and acquired competences:**
	The students will get acquainted with the knowledge about power systemprotection concepts as well as related digital signal processing algorithms. The students will be able to use appropriate means as well as prepare settings of protection for any network elements and structures.
	
	Contents:
	• Concepts and requirements of power system protection
	• Protection of particular network elements
	  ◦ power lines
	  ◦ transformers
	  ◦ generators
	  ◦ busbars
	• Digital signal processing for protection purposes
	  ◦ digital filtering
	  ◦ calculation of protection criteria
	  ◦ decision-making and logic
	• Adaptive and intelligent protection systems
	  ◦ adaptive and multi-criteria systems
	  ◦ artificial intelligence – based systems
	• wide-area protection concepts

Literature	
Language	English
Forms of teaching	Lecture, Exercise
Requirements for participation	Knowledge of power system basics
Usability of the module	Compulsory elective module for the Master Course "Electrical Engineering and Information Technology".
Examinations prerequisite	None
Exam performance	Written exam 120 minutes at the end of the module and project report
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 1 SWS Exercise Autonomous work: Post processing of lectures, preparation of project report and exam
Availability	Every year in the summer semester
Duration of the module	One Semester (block-wise at the end of semester)
Responsible lecturer	Prof. Dr.-Ing. habil. Waldemar Rebizant (WUST-FEE)

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2.4.3 Electromagnetic Compatibility (EMC)

English title	Electromagnetic Compatibility
Qualification goals and contents of the module	**Learning objectives and acquired competences:** The students gain information on the fundamental concepts, principles and measurement techniques of electromagnetic compatibility (EMC). At the end of the module, they are able to understand and apply measures to improve the EMC of electric and electronic systems. They will also be able to analyze the EMC of electrical systems. **Contents:** • Introduction • EMC regulation • EM coupling, shielding, filtering • EMC analysis • Interference models for special applications • EMC measures in electronic circuits • Measurement techniques
Literature	[1] K.-H. Gonschoreck, R. Vick: Electromagnetic Compatibility for Device Design and System Integration. Springer Verlag
Language	English
Forms of teaching	Lecture, Exercise
Requirements for participation	Bachelor in Electrical Engineering or related studies
Usability of the module	Compulsory elective module for the Master Course "Electrical Engineering and Information Technology" and "Medial System Engineering".
Examinations prerequisite	None
Exam performance	Oral test at the end of the module
Credit points and grades	4 SWS / 5 CP = 150 h (56 h time of attendance + 94 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 2 SWS Exercise Autonomous work: Post processing of lectures and laboratory work, preparation of exercises, laboratory work, research report and exam
Availability	Every year in the winter semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr.-Ing. Ralf Vick (FEIT-IMT)

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2.4.4 Power Electronic Components and Systems

English title	Power Electronic Components and Systems

Qualification goals and contents of the module	**Learning objectives and acquired competences:**
	Knowledge about power semiconductor components as part of power supply or drive systems shall be imparted, considering the mutual interaction between component and system level. Applications will be demonstrated in the exercise. To strengthen the competence for interdisciplinary work, consideration of questions of reliability shall show cross-links to related fields of engineering.
	
	Contents:
	• power electronic components
	  ◦ functionality, ratings and characteristics of IGBT, MOSFET and diode
	  ◦ packaging and assembly
	• power electronic systems
	  ◦ component stress in selected power supply and drive systems
	  ◦ dimensioning
	  ◦ reliability

Literature	[1] Ned Mohan: Power electronics - converters, applications and design; Wiley, Hoboken NJ, 3rd edition 2003
Language	English
Forms of teaching	Lecture, Exercise
Requirements for participation	Bachelor in Electrical Engineering or related studies and Master Course "Power Electronics"
Usability of the module	Selectable module for the Master Course "Electrical Engineering and Information Technology", belonging to the field of electrical energy systems.
Examinations prerequisite	None
Exam performance	Written exam 90 minutes at the end of the module
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 1 SWS Exercise Autonomous work: Post processing of lectures, preparation of exercises and exam
Availability	Every year in the winter semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr.-Ing. Andreas Lindemann (FEIT-IESY)

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2.4.5 Power System Economics and Special Topics

English title	Power System Economics and Special Topics
Qualification goals and contents of the module	**Learning objectives and acquired competences:** The student will learn • the main principles of high voltage and high current engineering. • the principles of materials used as isolator. • how to calculate economics of power systems. • how the energy market is structured and organized. • how to calculate the reliability and ability of power grid components. • how energy trading is organized and power prices will be calculated. **Contents:** • Electric power market and its liberalization • Financing account • The costs of transmission • Liberalization of European energy market • Energy trading • Network reliability • Network planning • Computing in network planning • High voltage measurement • High voltage and high current generation • Isolation materials • Isolation technology engineering • Use of high voltage technology in testing
Literature	[1] "Fundamentals of Power System Economics", Daniel S. Kirschen, Goran Strbac, John Wiley & Sons Ltd, 2004 [2] "Power System Economics: designing marktes for electricity", Steven Stoft. Wiley Interscience, 2002
Language	English
Forms of teaching	Lecture, Exercise
Requirements for participation	Bachelor in Electrical Engineering or related studies
Usability of the module	Compulsory elective module for the Master Course "Electrical Engineering and Information Technology".
Examinations prerequisite	None
Exam performance	Written exam 90 minutes at the end of the module
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 1 SWS Lecture, 2 SWS Exercise Autonomous work: Post processing of lectures, preparation of exercises and exam
Availability	Every year in the winter semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr.-Ing. habil. Martin Wolter (FEIT-IESY)

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2.4.6 Power System Dynamics

English title	Power System Dynamics

Qualification goals and contents of the module	**Learning objectives and acquired competences:**
	By completing the module, the students acquire in-depth knowledge of the characteristic transient behavior of electric power systems. Extended modeling and calculation methods are taught that consider the dynamic properties of both the individual equipment and the overall system. The participants will be able to design the required models and to apply them when performing transient simulations of power systems.
	
	Contents:
	• Power system dynamic simulation
	    ◦ Modal components
	    ◦ State space models
	    ◦ Extended nodal approach
	    ◦ differential conductance method
	• Dynamic models of equipment
	    ◦ Lines, transformers, generators, motors
	    ◦ Switching operations
	• Dynamic security assessment
	• Matlab seminar

Literature	
Language	English
Forms of teaching	Lecture, Exercise, Matlab Seminar
Requirements for participation	Power Network Planning and Operation
Usability of the module	Compulsory elective module for the Master Course "Electrical Engineering and Information Technology", belonging to the field of electrical energy systems.
Examinations prerequisite	None
Exam performance	Oral test at the end of the module
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 1 SWS Exercise Autonomous work: Post processing of lectures, solving of exercises, preparation of exercises and exam
Availability	Every year in the summer semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr.-Ing. habil. Martin Wolter (FEIT-IESY)

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2.4.7 Renewable Energy Sources

English title	Renewable Energy Sources
Qualification goals and contents of the module	**Learning objectives and acquired competences:** The student will learn about energy conversion processes of different types of renewable energy sources, the regulatory framework and the challenges of grid integration. Thereby, wind energy, photovoltaic systems, biomass and fuel cells are focused. Grid integration includes possibilities and limitations of energy storage as well. **Contents:** • Introduction to Renewable sources • Legal Framework, priority and subsidies • Functionality of energy conversion • Introduction to Fuel Cells • Introduction to energy storage
Literature	[1] "Renewable Energy Systems Fundamentals, Technologies, Techniques and Economics", Z. A. Styczynski, N. I. Voropai (Editors), ISBN: 978-3-940961-42-6, 2010 [2] "Power Conversion of Renewable Energy Systems", E. F. Fuchs, Mohammad A. S. Masoum, Springer-Verlag, 2011
Language	English
Forms of teaching	Lecture, Exercise
Requirements for participation	Bachelor in Electrical Engineering or related studies
Usability of the module	Compulsory elective module for the Master Course "Electrical Engineering and Information Technology".
Examinations prerequisite	None
Exam performance	Written exam 90 minutes at the end of the module
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 1 SWS Exercise Autonomous work: Post processing of lectures, preparation of exercises and exam
Availability	Every year in the summer semester
Duration of the module	One Semester
Responsible lecturer	Prof. Dr.-Ing. habil. Martin Wolter (FEIT-IESY)

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2.5 General

2.5.1 Basics of Medical Image Science

English title	Basics of Medical Image Science
Qualification goals and contents of the module	**Learning objectives and acquired competences:** The Student will: • get an overview about radiation principles including types of ionizing radiation and their behaviour • learn about the difference between active and passive imaging methods and examples from medical imaging techniques • get to know system theory of medical imaging systems • learn to understand the differences between Fourier-based and task-based image quality descriptions • understand how image quality can be described by different types of observers (human and model observers) **Contents:** • Radiation physics for alpha-, beta-, gamma-, neutron- and X-ray radiation • MTF, NPS and DQE • Ideal observer, human observer models, ROC curves
Literature	provided by e-learning system
Language	English
Forms of teaching	Lecture, Exercise
Requirements for participation	Recommended: Mathematics, Physics, Fundamentals in Electrical Engineering
Usability of the module	Master program
Examinations prerequisite	None
Exam performance	Written exam of 90 minutes at the end of the module
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 1 SWS Exercise Autonomous work: Rework of lectures and exercises, preparation of exercises
Availability	Every summer semester (starting from summer term 2022)
Duration of the module	One Semester
Responsible lecturer	Prof. Dr. rer. nat. Christoph Hoeschen (FEIT-IMT)

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2.5.2 Integrated Project

English title	Integrated Project
Qualification goals and contents of the module	**Learning objectives and acquired competences:** This module serves to improve and apply the knowledge gained in a research-related topic. The student will develop his skills to work on a scientific topic under supervision. He will learn to perform research including accessible literature. In addition, the student will be able to develop his own research project. **Contents:** The content of teaching is largely determined by the research project.
Literature	
Language	English
Forms of teaching	Scientific project
Requirements for participation	Bachelor in Electrical Engineering or related studies
Usability of the module	Compulsory elective module for the Master Course "Electrical Engineering and Information Technology".
Examinations prerequisite	None
Exam performance	Research project (PRO)
Credit points and grades	6 SWS / 10 CP = 300 h (84 h time of attendance + 216 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 6 SWS Scientific project Autonomous work: Post processing of seminars and tutorials, preparation and performance of scientific work, preparation of presentations and a project
Availability	Every year in the winter semester
Duration of the module	One Semester
Responsible lecturer	Supervisor of the project

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2.5.3 Micro optics

English Title	Micro optics
Qualification goals and contens of the module	**Learning objectives and acquired competences:** After completing this course, the students will have acquired on the one hand a background in optics that is relevant to apply and derive the working principles of micro-optical devices and understand their limitations. On the other hand, they will have a broad overview over the working principles of the most common micro-optical devices. **Content:** 1. Review of optics • Geometric optics • Wave optics ◦ Diffraction, interference ◦ Fourier optics ◦ Propagation in a wave guide 2. Micro-Optomechatronic devices for imaging and beam shaping • Adaptive lenses • Adaptive mirrors and spatial light modulators • Scanning mirrors • Micro lenses, Shack-Hartmann sensor 3. Micro-optical devices for fiber optics • Fiber optic switches • Ring resonators, whispering gallery resonators • Elements of integrated fiber optics 4. Meta optics • Optical metamaterials, photonic crystals • Diffractive optics, metalenses
Literature	
Language	German/English
Forms of teaching	Lecture, Exercise
Requirements for participation	Engineering mathematics and physics, e.g., bachelor degree in Electrical Engineering, Mechanical Engineering, Physics or related discipline. Basic knowledge of micro mechanics and micro actuators is recommended.
Usability of the module	Compulsory elective module in the master's degree program EEIT as well as other master's degree programs of FEIT.
Examinations prerequisite	None
Exam performance	Oral test at the end of the module
Credit points and grades	4 SWS / 5 CP = 150 h (56 h time of attendance + 94 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 2 SWS Exercise Autonomous work: Post processing of lectures, solving and preparation of exercises, preparation of exam
Availability	Every year in the winter semester
Dauer des Moduls	One Semester
Modulverantwortlicher	Prof. Dr. Matthias Wapler (FEIT-IMT)

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2.5.4 Micromechanics

English Title	Micromechanics
Qualification goals and contens of the module	**Learning objectives and acquired competences:** Micromechanics is the core that sets apart micro-electromechanical systems (MEMS) from microelectronics. While the laws of physics on the micro scale are the same as on the macro scale, different effects become relevant, resulting in different engineering concepts. After completing this module, the students are aware of the general mechanical engineering concepts of micro-electromechanical systems and the most common structural and functional components. They are further equipped with the understanding and the tools to quickly estimate the mechanical response such as displacements, forces, flow speeds or resonance frequencies either from the response of building blocks that we derive in classes or from first principles. In combination with the application examples, this puts them in the position to find suitable MEMS solutions based on conventional building blocks and to develop new fundamental working principles. **Content:** 1. Introduction, comparison of macro and micro scale 2. Solid mechanics • Cantilever springs • Spring systems • Resonances 3. Micro fluidics • Basic fluidic equations, flow profiles, turbulence • Surface tension, capillary effect, droplet generation • Diffusion 4. Micro actuators • Fundamental motivation of principle of least action; Euler-Lagrange equation; principle of virtual work • Electrostatic actuators: Parallel plate, pull-in effect, comb drives, electrowetting, dielectric electroactive polymers; Paschen effect • Magnetic actuators: Lorentz force, voice coil actuators, reluctance actuators • Solid state actuators: Piezo actuators, thermal actuators, bending actuators, 1D and 2D buckling actuators, shape memory materials 5. Application examples and devices • Micro pumps, valves, flow sensor • Smart phone camera • Acceleration sensors, MEMS gyroscopes • Inkjet printer • Other examples TBD
Literature	
Language	English
Forms of teaching	Lecture, Exercise
Requirements for participation	Engineering mathematics and physics, e.g., bachelor degree in Electrical Engineering, Mechanical Engineering, Physics or related discipline.
Usability of the module	Compulsory elective module in the master's degree program EEIT as well as other master's degree programs of FEIT.
Examinations prerequisite	None
Exam performance	Oral test at the end of the module

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Credit points and grades	4 SWS / 5 CP = 150 h (56 h time of attendance + 94 h autonomous work) Grading scale as per examination regulations
Work effort	Time of attendance: 2 SWS Lecture, 2 SWS Exercise Autonomous work: Post processing of lectures, solving and preparation of exercises, preparation of exam
Availability	Every year in the winter semester
Dauer des Moduls	One Semester
Modulverantwortlicher	Prof. Dr. Matthias Wapler (FEIT-IMT)

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2.5.5 Microsystems Processes and Technologies

English Title	Microsystems Processes and Technologies
Qualification goals and contens of the module	**Learning objectives and acquired competences:** After completing this module, the students are aware of the general fabrication processes of micro systems. They will know the general strategy of how to build a micro system with additive and subtractive processes, the implications on micro systems design and the individual processes and their limitations. They will also have a general understanding of the relevant materials and the characterization techniques. While we will focus on the fabrication of micro electro mechanical systems such as sensors and micro actuators, the concepts are transferable to micro electronics, and we will also briefly cover the relevant nanometer-scale lithography. We will cover both the classical cleanroom-based processes and modern rapid prototyping processes, and in addition, we will cover the most relevant traditional inorganic and modern organic materials and the structural, chemical and dynamic MEMS characterization techniques. **Content:** 1. Introduction • Why not classical fabrication? Parallel vs. serial processes. Planar systems • Basic MEMS materials, silicon • Clean rooms, yield, wafers 2. Classical micro processes • Lithography: Optical, EUV, multi-patterning, e-beam, x-ray • Subtractive processes: Chemical, physical, (an)isotrophy, selectivity • Additive processes: Surface modification, thin film, thick film, physical, chemical, epitaxy • Back end processes: Bonding, contacting, encapsulation, dicing • Special processes: DRIE, LIGA 3. Modern/rapid prototyping processes • Laser ablation • 2-photon lithography • Surface nano structures • Alternative/organic MEMS materials 4. Characterization techniques • (Electron) microscopy • X-ray Spectrometry, diffractometry • Force microscopy, surface profilometry • Interferometry, vibrometry
Literature	
Language	English
Forms of teaching	Lecture
Requirements for participation	Basic chemistry and physics, e.g., bachelor degree in engineering, natural sciences or related disciplines.
Usability of the module	Compulsory elective module in the master's degree program EEIT as well as other master's degree programs of FEIT.
Examinations prerequisite	None
Exam performance	Oral test at the end of the module
Credit points and grades	3 SWS / 5 CP = 150 h (42 h time of attendance + 108 h autonomous work) Grading scale as per examination regulations

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Work effort	Time of attendance: 3 SWS Lecture Autonomous work: Post processing of lectures, studying of suggested papers and literature, preparation of exam
Availability	Every year in the summer semester
Dauer des Moduls	One Semester
Modulverantwortlicher	Prof. Dr. Matthias Wapler (FEIT-IMT)

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3 Master Thesis

3.1 Master Thesis

English title	Master Thesis
Qualification goals and contents of the module	**Learning objectives and acquired competences:** Students can work in a research-oriented and scientific manner. They can select and apply suitable scientific methods to solve a defined problem and critically evaluate and classify the results obtained. They can identify information needs, find and obtain information. Students are able to write a research-oriented scientific text to the extent of a Master's thesis. The student is able to present this work and to answer questions scientifically. **Contents:** after arrangement with the advisor
Language	English
Forms of teaching	Term paper, presentation
Requirements for participation	See study and examination regulations
Usability of the module	There is no interaction with other modules.
Examinations prerequisite	According to the requirements of the study and examination regulations
Exam performance	Term paper, presentation Submission of a scientific text with novelty character prepared by the participant himself/herself, as part of a Master's thesis as well as the presentation and defence of the thesis.
Credit points and grades	30 CP = 900 h autonomous work Grading scale as per examination regulations
Work effort	After topic-specific agreement with the advisor autonomous work: Research-oriented scientific work
Availability	Every year in the summer semester or winter semester
Duration of the module	One Semester
Responsible lecturer	Supervisor of the Master Thesis

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