Modulhandbuch

Computing Science - Master's Programme

im Summer semester 2025

erstellt am 27/04/25

Kernmodule

inf900 - Group Project

Module label	Group Project
Module code	inf900
Credit points	24.0 KP
Workload	720 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Kernmodule • Master's Programme Computing Science (Master) > Kernmodule • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Boles, Dietrich (module responsibility) • Boll-Westermann, Susanne (module responsibility) • Marx Gómez, Jorge (module responsibility) • Peter, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Useful prerequisites: Good skills in programming and software development, as well as soft skills and knowledge in project management.
Skills to be acquired in this module	Participants primarily acquire specialized knowledge, skills, and competencies in the area of the assigned topic. Due to the size and complexity of the topics and their team-based approach, participants develop key competencies such as project management, teamwork, problem-solving abilities, and conflict resolution. For topics focused on software development, skills and knowledge in software engineering are also conveyed. **Subject Competencies** The students: • recognize and evaluate the techniques and methods applicable in their specialty and their limitations • design solutions for complex, possibly poorly defined, or unusual tasks in the field of computer science and evaluate such designs according to the state of the art • identify, structure, and solve problems even in new or emerging areas of their discipline • apply state-of-the-art and innovative methods to investigate and solve problems, possibly drawing on other disciplines • relate knowledge from different disciplines and apply these synergies in complex situations • develop complex computer systems, processes, and data models • evaluate and validate developed approaches and methods through empirical or theoretical analyses • recognize the limits of current knowledge and technology and contribute to the further scientific and technological development of computer science • discuss current developments in computer science and assess their significance • formulate scientific hypotheses and conduct theoretical and practical investigations to validate them • document and present research results according to scientific standards **Method Competencies** The students: • find and design one or more approaches to solutions • evaluate tools, technologies, and methods and apply them in a differentiated manner • investigate problems using technical and scientific literature

- plan timelines and other resources
- apply project management techniques
- creatively develop new and original approaches and methods
- conduct systematic and thorough literature searches to determine the current state of research
- use scientific databases and other resources to support their research
- validate developed methods and models through theoretical or practical tests
- write articles according to scientific principles and present their results in scientific lectures

Social Competencies

The students:

- integrate criticism into their own actions
- respect the decisions made in the team
- communicate convincingly orally and in writing with users and professionals
- identify sub-tasks and take responsibility for them
- work effectively in interdisciplinary teams, respecting different professional perspectives
- discuss and defend their research results in scientific discussions and forums

Self-Competencies

The students:

- take on leadership roles in the team
- critically follow further developments in computer science in general and in their specialty
- carry out innovative activities in their field successfully and independently
- recognize the limits of their competence and expand them in a targeted manner
- reflect on their self-image and actions from professional, methodological, and social perspectives
- develop and reflect on their own theories based on independently formulated hypotheses
- work independently in their field
- show initiative and self-discipline in pursuing scientific questions
- plan and structure research work independently and efficiently

Module contents

Collaborative work (in a suitably sized team) on a larger task in the field of computer science, requiring a methodical and systematic approach tailored to the specific task. The project groups will focus on the research topics of Oldenburg Computer Science. If the project centers on software development, the methods and techniques taught in the computer science curriculum should be systematically applied.

Recommended reading

Will be announced in the associated course

Links

https://uol.de/informatik/studium-lehre/studiengaenge/master-studiengaenge/projektgruppen

Languages of instruction	German, English
Duration (semesters)	2 Semester
Module frequency	semi-anual
Module capacity	unlimited

Reference text

The topics available for selection by the project groups are typically presented at the end of the lecture period of the preceding semester. Following this, there is an opportunity to register for a topic. Only those topics that receive a minimum number of registrations will actually be offered as courses.

Teaching/Learning method	PG	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	accompanying the course	project

Type of course	Project group
SWS	16
Frequency	SuSe and WiSe
Workload attendance time	112 h

inf903 - Research Project I

Module label	Research Project I
Module code	inf903
Credit points	12.0 KP
Workload	360 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Kernmodule • Master's Programme Computing Science (Master) > Kernmodule • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Marx Gómez, Jorge (module responsibility) • Peter, Andreas (module responsibility) • Boll-Westermann, Susanne (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	The “Research Project” modules (inf903 and inf904) can replace the project group for students who are spending a semester abroad.
Skills to be acquired in this module	The Module practices the scientific competencies in preparation of the master thesis. It is intended to replace the project group with the two “Research Project” modules to ensure studibility and to enable students to perform research projects at foreign universities. Additionally, it is also intended to embed the student into the research activities of the supervisor in preparation of a potential doctoral work after finishing the program.
Module contents	Definition of a research question, identifying the state of the art, development of a research plan, performing research tasks, scientific writing, presentation of results. **Professional competence** The students: • will extend their competences in the required technologies of the research area **Methodological competence** The students: • will extend their competences in scientific methodologies, methods, and tools regarding the research are **Social competence** The students: • will be integrated in the working group of the supervisor of the work and have to present as well as discuss the results within the working group **Self-competence:** The students: • recognise their abilities and extend them purposefully • reflect their self-perception and actions with regard to professional, methodological and social aspects- • develop and reflect self-developed hypothesis to theories independently • work in their field independently
Recommended reading	Will be announced by the supervisor according to the research topic.
Links	

Languages of instruction	English , German
Duration (semesters)	1 Semester
Module frequency	individually
Module capacity	unlimited
Reference text	The “Research Project” modules (inf903 and inf904) can replace the project group for students who are spending a semester abroad.
Teaching/Learning method	P

Examination	Prüfungszeiten	Type of examination
Final exam of module	Individually in consultation with the teachers	Project

Type of course	Project
SWS	6
Frequency	SuSe or WiSe
Workload attendance time	46 h

inf904 - Research Project II

Module label	Research Project II
Module code	inf904
Credit points	12.0 KP
Workload	360 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Kernmodule • Master's Programme Computing Science (Master) > Kernmodule
Responsible persons	• Marx Gómez, Jorge (module responsibility) • Peter, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	The “Research Project” modules (inf903 and inf904) can replace the project group for students who are spending a semester abroad.
Skills to be acquired in this module	The Module improves the scientific competencies in preparation of the master thesis. It is intended to replace the project group with the two “Research Project” modules to ensure studibility and to enable students to perform research projects at foreign universities. Additionally, it is also intended to embed the student into the research activities of the supervisor in preparation of a potential doctoral work after finishing the program. **Professional competence** The students: • will improve their competences in the required technologies of the research area**.** **Methodological competence** The students: • will improve their competences in scientific methodologies, methods, and tools regarding the research area. **Social competence** The students: • will be integrated in the working group of the supervisor of the work and have to present as well as discuss the results within the working group. **Self-competence:** The students: • know their abilities and extend them purposefully • reflect their self-perception and actions with regard to professional, methodological and social aspects • develop and reflect self-developed hypothesis to theories independently • work in their field independently
Module contents	Definition of a research question, identifying the state of the art, development of a research plan, performing research tasks, scientific writing, presentation of results
Recommended reading	Will be announced by the supervisor according to the research topic.
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester

Module frequency	individually	
Module capacity	unlimited	
Reference text	The “Research Project” modules (inf903 and inf904) can replace the project group for students who are spending a semester abroad.	
Teaching/Learning method	P	
Examination	Prüfungszeiten	Type of examination
Final exam of module		Project

Type of course	Project Project
SWS	4
Frequency	WiSe
Workload attendance time	46 h

Praktische Informatik

inf006 - Software Engineering II

Module label	Software Engineering II
Module code	inf006
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Bachelor's Programme Business Informatics (Bachelor) > Akzentsetzungsbereich Praktische Informatik und Angewandte Informatik • Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik • Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Praktische Informatik) • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Praktische Informatik • Master's Programme Environmental Modelling (Master) > Mastermodule
Responsible persons	• Winter, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	

Expected/useful experience

from inf005 - Software Engineering I

Professional competence
The students:

- recognize the phases in the software life cycle (requirements elicitation, design, implementation, quality assurance)
- name the tasks involved in each phase
- recognize and evaluate the arrangement of these activities in classic and agile approaches
- assess and select suitable process models for the realization of projects
- understand the advantages of the modelling process with UML
- develop and evaluate models in different UML notations and their combinations
- solve given problems with the help of UML notations

Methodological competence
The students:

- structure, evaluate, differentiate and use procedures of classic and agile project management
- structure, document and evaluate problems and solutions using the tools of object-oriented modeling
- apply methods and techniques of object-oriented modeling with UML in a targeted manner

Social competence
The students:

- create, present and discuss solutions to problems using modeling techniques
- describe and solve given modeling problems in teams

Self-competence
The students:

- reflect on their actions when describing problems and developing solutions

Skills to be acquired in this module

The aim of Software Engineering II is to deepen the topics covered in the Software Engineering. Using blended leaning methods, students deepen their knowledge of software architecture. In the lecture part, the basics of software architecture and selected topics are presented. Students work together research-oriented to develop an overview of the current literature and the current state of research and practical application of methods and techniques in software architecture. In individual presentations, the students detail selected topics and document them in a joint script. This is supplemented by (invited) lectures on current architecture topics.

Professional competence
The students:

- deepen methods and techniques of software engineering
- apply methods and techniques of software engineering specifically to describe, analyze and evaluate software architectures
- differentiate between techniques for the development of software architectures
- implement functional and non-functional requirements in software architectures and independently evaluate and reflect on these solutions

Methodological competence
The Students:

- develop a current research map of software architecture
- identify current methods and techniques of software architecture
- identify and discuss cross-references between the topics of the lecture and the contributions of fellow students
- present current solution approaches

Social competence
The Students:

- explain and discuss software engineering solutions in their practical application
- accept criticism and understand it as assistance

Self-competence
The Students:

- reflect on their actions when identifying approaches to solve software architecture issues
- internalize the development methods presented and add them to their actions

Module contents

The following subjects are provided:

- software architecture terminology, software architect, necessity of software architectures
- architecture description, views and viewpoints, architecture patterns, reference viewpoints
- software architecture development procedures (Siemens, 4+1),
- formal and informal software specification
- model-driven architecture
- domain-specific languages
- software architecture migration

Topics developed and presented individually by students include (depending on the personal interests of the participants)

- quality of software architectures
- concrete architecture patterns, styles, viewpoints
- software deployment
- distributed architectures, service-oriented architectures, component-oriented architectures, software-defined vehicles, event-driven architecture, architecture of IoT systems/CPS, etc
- agile software architecture
- evolution of software architectures
- evaluation and simulation of software architectures

Recommended reading

- Slide script for the lecture
- Ian Sommerville: Software Engineering, Addison-Wesley Longman, Amsterdam, 10. Auflage (Global Edition). 2015.
- Helmut Balzert: Lehrbuch der Software-Technik, Spektrum Akademischer Verlag, 3. Auflage 2009.
- Christine Hoffmeister, Robert Nord, Dilip Soni: Applied Software Architecture, Addison Wesley (1. November 1999)
- Len Bass, Paul Clements, Rick Kazman: Software Architecture in Practice (SEI Series in Software Engineering), Addison Wesley; 4. Edition (3. August 2021)
- Paul Clements, Felix Bachmann, Len Bass, David Garlan, James Ivers , Reed Little, Paulo Merson, Robert Nord, Judith Stafford: Documenting Software Architectures: Views and Beyond (SEI Series in Software Engineering), Addison-Wesley Educational Publishers Inc; 2. Edition (5. Oktober 2010)
- and actual papers from IEEE Software, IEEE Transactions on Software-Engineering, Informatik-Spektrum und various conferences (ICSE, ICSME, SANER, ICPC, SLE, MODELS etc.)

Links	
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	every summer term
Module capacity	unlimited
Teaching/Learning method	V+S

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	Accompanying lectures operation	portfolio - Active participation (including presentation and discussion of various interim results, self-report) - Presentation 30-45 min - Elaboration 4-6 pages IEEE

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	28
Seminar		2	SuSe	28
Total module attendance time				56 h

inf040 - Introduction to Data Science

Module label	Introduction to Data Science
Module code	inf040
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Bachelor's Programme Business Informatics (Bachelor) > Akzentsetzungsbereich Praktische Informatik und Angewandte Informatik • Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik • Bachelor's Programme Sustainability Economics (Bachelor) > Wahlpflichtbereich • Master Applied Economics and Data Science (Master) > Data Science • Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Praktische Informatik) • Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Theoretische Informatik) • Master of Education Programme (Hauptschule and Realschule) Computing Science (Master of Education) > Mastermodule • Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) > Akzentsetzungsbereich • Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Wingerath, Wolfram (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Basics of databases, Python programming and statistics
Skills to be acquired in this module	The module teaches fundamentals from the field of Data Science, covering purposes, challenges, and common best practices. **Professional competences** The students • have knowledge of basic concepts, problems and solution approaches from the field of Data Science. • are able to justify the choice of specific data analysis methods for a given problem • include possible imponderables in the analysis when evaluating analysis results **Methological competences** The students • are able to translate questions from a specific domain into a feasible analysis • work on Data Science tasks to expand their understanding of the different approaches and methods. **Social competences** The students • discuss approaches and problems encountered in smaller and larger groups **Self competences** The students • reflect on their actions when identifying possible solutions and critically question their own results
Module contents	

	Data Science is an interdisciplinary science at the intersection of statistics, machine learning, data visualization, and mathematical modeling. This course is designed to provide a practical introduction to the field of Data Science by teaching theoretical principles while also applying them practically. Topics covered range from data collection and preparation (data sources & formats, data cleaning, data bias), mathematical foundations (statistical distributions, correlation analysis, significance) and methods for visualization (tables & plots, histograms, best practices) to the development of models for classifying or predicting values (linear regression, classification, clustering).
Recommended reading	- The Data Science Design Manual (Seven Kiena, 2017) - Invisible Women: Data Bias in a World Designed for Men (Caroline Criado-Perez, 2019)
Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	in winter term
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period or by arrangement with the instructor.	Written or oral exam or portfolio or project or practical exercise

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf100 - Human Computer Interaction

Module label	Human Computer Interaction
Module code	inf100
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Praktische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction
Responsible persons	• Boll-Westermann, Susanne (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Useful previus knowledge: Interactive Systems
Skills to be acquired in this module	With the help of suitable resources, the students can design, prototype, and evaluate a human-machine interface following the user-centered design process (HCD). **Professional competence** The students: • can describe and explain the HCD process. • can classify an unknown method into the HCD process when they are presented with a brief description. • can select a suitable prototyping approach for a given application. • can select a suitable prototyping method for a given application. • can apply selected prototyping methods to create an interactive system. • can name basic characteristics of human perception and motor skills and explain their importance for the development of interactive systems. • can suggest and motivate improvement for a given user interface based on the gestalt laws. • can explain the characteristics of human visual search and utilize it to improve given interfaces. • can critically compare several variants of an interactive system's concept based on the "Multiple Resource Theory". **Methoden competence** The students: • can critically compare and select methods for context of use and/or user requirements analysis. • can apply methods for context of use and/or user requirements analysis to a real-world example. • can retrospectively discuss and evaluate the use of a method for context of use and/or user requirements analysis. • can plan, moderate and evaluate an ideation session. • can formulate a precise research question based on a given problem description. • can discuss the advantages and disadvantages of an experiment design. • can select a suitable experiment design for a given research question. • can define hypotheses and null hypotheses for a given experiment. **Social competence** The students: • can work out solutions for a given design problem in group work. • can present solutions to design problem in the plenum. • can motivate their methodical approach to a design problem. • can discuss their designs and results in an appropriate and professional manner with the plenum. • can accept criticisms by their peer group as valuable contributions to their designs.

	Self-competence: The students: • can accept and learn from mistakes made during the design process.
Module contents	The module covers research methods in the field of human-computer interaction. It discusses the core principles of human-computer interaction and the human-centered design process and its phases, context of use, requirements, and task analysis, prototyping and evaluation. Research methods used in the different phases of the process are introduced and discussed. Available design options for human-machine interfaces are presented and discussed with regard to human perception capabilities and their limitations. The module discusses methods for user research, including surveys, diaries, case studies, interviews, and focus groups, as well as physiological measurements. The module goes into further detail on evaluation methods, and introduces the foundations of experimental research in human-computer interaction, including types of research, research hypotheses, experimental design, and statistical analysis. During the practical project, a concrete human-computer interface will be designed, developed and evaluated.
Recommended reading	• Lazar, Jonathan, Jinjuan Heidi Feng, and Harry Hochheiser. Research methods in human-computer interaction. Morgan Kaufmann, 2017. • Literature in the reserve shelf in the university bibliography. • Link list in Stud.IP.
Links	https://uol.de/en/media-informatics/teaching/courses
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	every summer term
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module	The completed practical projects will be presented on a single project day, which will take place at the end of the lecture period. The oral exam takes place within the last two weeks of the lecture period. If necessary, re-examinations will take place at the end of the term. Details on the schedule can be found on the websites of the department and in Stud.IP.	Portfolio

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	28
Exercises		2	SuSe	28
Total module attendance time				56 h

inf105 - Fault Tolerance in Distributed Systems

Module label	Fault Tolerance in Distributed Systems
Module code	inf105
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Theel, Oliver (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Useful prior knowledge: Knowledge in the field of distributed operating systems
Skills to be acquired in this module	This module provides knowledge of fault-tolerant distributed systems. The terminology, structure, conception, core challenges and related implementation concepts will be covered in detail. **Professional competence** The students: • assess what a fault-tolerant distributed system is and develop awareness of its capabilities • name and discuss common implementations of fault-tolerant distributed systems **Methodological competence** The students: • reflect the implementation challenges of a distributed system • are able to adapt and evolve implementation concepts of fault-tolerant distributed systems in new contexts **Social competence** The students: • solve problems in small teams • present their solutions to the members of the tutorial • discuss their different solutions with members of the tutorial **Self-competence** The students: • accept criticism • question their initially applied methods for problem solving • question their initial solutions in the light of newly learned methods
Module contents	1. Fault, Error, Failure 2. Failure semantics, Fault tolerance 3. Byzantine agreement protocols 4. Stable storage 5. Fail-stop processors 6. Atomic commit protocols 7. Classification of replication control schemes - pessimistic vs. optimistic - semantic vs. syntactic - static vs. dynamic 8. Consistency notions 9. Quality criteria 10. Survey of replication control schemes 11. Design of replication control schemes 12. Unifying frameworks 13. Replication in practice
Recommended reading	• P. Jalote (1994): Fault Tolerance in Distributed Systems. Prentice-Hall.

- A. Helal et. Al (1996): Replication Techniques in Distributed Systems. Kluwer Academics
- A. Schiper et. Al (2010): Replication: Theory and Practice

Links		
Language of instruction		German
Duration (semesters)		1 Semester
Module frequency		annual
Module capacity		unlimited
Teaching/Learning method		V+S or V+Ü
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	End of lecture period	Written exam or oral exam or practical work

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Seminar or exercise		2	WiSe	28
Total module attendance time				56 h

inf108 - Requirements Engineering and Management

Module label	Requirements Engineering and Management
Module code	inf108
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Winter, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	
Skills to be acquired in this module	

The objective of the module "Requirements Engineering and Management" is to convey the core concepts and technology of the requirements engineering and requirements management.

The lecture follows research oriented teaching methodologies by applying these methods and techniques practically to develop an exemplary requirements definition, starting in the second part of the semester.

Professional competence

The students:

- are aware of the necessity of requirements engineering and management
- integrate the process of requirements engineering in the software engineering process
- name methods and tools of requirements engineering and management
- differentiate classical and agile methods and techniques of requirements documentation and management
- select and apply methods and tools from requirements engineering and management to solve given problems appropriately
- illustrate the key tasks of the requirements engineering and management
- name essential concepts to develop and to structure ideas
- discuss methods of anayzing requirements and develop validation concepts

Methodological competence

The students:

- apply methods of elicitation, documentation,validation and confirmation of requirements
- create a comprehensive requirement document in group work
- follow problem oriented procedures
- abstract from concrete programming languages

Social competence

The students:

- communicate with all stakeholders dealing with software development
- design project visions in groups
- collect requirements in interviews
- design requirements for software systems collaboratively
- contrast classical and agile requirements documents in groups

Self-competence

The students:

- reflect their problem-solving behaviour by applying requirements engineering and management capabilities

Module contents

The module deals with requirements analysis core concepts as well as methods and techniques of requirements engineering and management.

Topics of this module are:

- the necessity of requirements engineering and management
- the requirements engineering process in the software development process
- requirements engineering process (participants, documents, activities)
- understanding the application domains (vision development, system environment documentation, domain model development, use case identification)
- requirements collection (functional and non-functional requirements, requirements collection, requirements documentation, requirements validation, requirements needs)
- requirements management

Recommended reading

- Slide script for the lecture (currently mixed bilingual)
- Chris Rupp: Requirements-Engineering und -Management, Das Handbuch für Anforderungen in jeder Situation, Hanser, München, 7. Auflage, 2020.
- Chris Rupp, Klaus Pohl: Requirements Engineering Fundamentals: A Study Guide for the Certified Professional forRequirements Engineering Exam - Foundation Level - IREB compliant, Rocky Nook; 2nd Ed. (5. Mai 2015)

Links	
Languages of instruction	English , German
Duration (semesters)	1 Semester
Module frequency	jährlich
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Portfolio: joint report, individual self assement report, and short oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf109 - Information Systems III

Module label	Information Systems III
Module code	inf109
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Grawunder, Marco (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	
Skills to be acquired in this module	Professional competence The students: • describe concepts, languages and architectures of database systems • discuss state-of-the-art database research topics • analyse information processing tasks and implement solutions appropriately **Methodological competence** The students: • propose concrete processing requirements for special application classes • assess the consequences of techniques and approaches • perform supervised research in the field of information systems • analyse and reflect complex information system requirements • realize information demands and accordingly gather aim-oriented information **Social Competencies** The students: • solve problems partially in small groups • present solution proposals in front of the exercise group • discuss their different solution proposals withhin the exercise group **Self-competences** The students: • accept constructive criticism • reflect on their proposed solution considering the taugth methods
Module contents	This module is a continuation of the content of information systems I and of information systems II. It deepens and extends the contents of the preceding modules and focuses mainly on current research questions. A special focus lies on concept of distributed data management.
Recommended reading	• Özsu, M. Tamer; Valduriez, Patrick, Principles of distributed database systems • Rahm/Saake/Sattler: Verteiltes und Paralleles Datenmanagement, Springeer • Paper from SIGMOD, VLDB or ICDE
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	Winter semester

Module capacity		unlimited	
Teaching/Learning method		V+Ü	
Examination	Prüfungszeiten		Type of examination
Final exam of module			
	At the end of the lecture period		Written or oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf111 - Advanced Database Practical

Module label	Advanced Database Practical
Module code	inf111
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Grawunder, Marco (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Useful prior knowledge: • Basics of database systems
Skills to be acquired in this module	Objective of the module/skills: The module enhances the previous knowledge of databases and information systems. In the context of a professional database system the students realize, implement, install and optimize the system. Theoretical and mathematical approaches are additional contents. Additionally the course provides the capability both to describe the differences between NoSQL Databases and (Object-)Relational Databases and how to use them. **Professional competence** The students: • name realisation techniques, implementations und programming of database systems • program and implement database oriented system routines • administer a professional database system - identify database system performance problems and solve them appropriately **Methodological competence** The students: • make optimisation decisions during the modelling phase • construct optimisation strategies mathematically **Social competence** The students: • develop appropriate implementations for given problems in a team **Self-competence** The students: • acknowledge the limits of their ability to cope with pressure during the implementation of database specific solutions
Module contents	Content of the Module: The module is a practical course. It is a continuation of the modules Information Systems I and Information Systems II. This module especially deals with the technical and theoretical concepts of database systems. Practical database implementation approaches and optimisation concepts are additional content of the module. In detail the module provides: low-level database management programming, aspects of catalogue systems implementation, optimisation strategies based on different parallelisation and partitioning strategies, query concepts and modification.
Recommended reading	Suggested reading:

- Ramez Elmasri und Shamkant B. Navathe (2007). Fundamentals of Databases Systems. Fifth Edition, Pearson/Addison Wesley.
- Held Andrea (2007), Oracle 10g Addison-Wesley.
- Held Andrea (2015), Oracle 12c New Features Addison Wesley.
- Feuerstein Steven, Pribyl Bill, Dawes Chip (2007). Oracle PL/SQL. 4. Auflage, O'Reillys Taschenbibliothek
- Oracle 10g, Das Programmierhandbuch, Galileo Computing
- Oracle Database 11g, DBA-Handbuch, Oracle Press-Hanser Verlag
- NoSQL (2011) Hanser Verlag

Links		
Language of instruction	German	
Duration (semesters)	1 Semester	
Module frequency	Summer semester	
Module capacity	unlimited	
Teaching/Learning method	P	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	During the lecture period and at the end of the lecture	Practical exercises and oral exam

Type of course	Practical training
SWS	4
Frequency	SuSe
Workload attendance time	56 h

inf112 - Modern Programming Technologies

Module label	Modern Programming Technologies
Module code	inf112
Credit points	6.0 KP
Workload	180 h (As part of the exercies, the students incrementally develop a complex software application in teams of 2 or 3 students. For this purpose, new subtasks with reference to the respective lecture content have to be worked on weekly. In the oral examination, the students have to show that they know the taught programming technologies and can use them appropriate when developing their own applications.)
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Boles, Dietrich (Module counselling) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	good programming skills
Skills to be acquired in this module	The objective of the module is to provide the students with modern programming technologies. After the course, the students are able to use these technologies during the development and implementation of complex applications. **Professional competence** The students: • name modern programming technologies • appropriate use modern programming technologies to solve complex problems **Methodological competence** The students: • search for solutions to specific problems in the internet independently **Social competence** The students: • develop software in teams • discuss own and someone else's solutions **Self-competence** The students: • reflect their problem-solving behaviour and take up new solutions, e.g. from the internet
Module contents	The module enhances the students' programming skills. It focuses on modern programming technologies. Among others, these are .NET-Framework, Java Server Technologies like Java EE or Spring, Android App development or the development of skills for digital voice assistants. The new technologies are presented in the lecture part. In the exercises, the students develop their own larger applications in groups of 2 or 3 students in reference to the lecture content.

Recommended reading

list of links in the learning management system

Links		
Language of instruction		German
Duration (semesters)		1 Semester
Module frequency		every winter term
Module capacity		12
Teaching/Learning method		V+Ü
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	The presentation of developed solutions takes place weekly during the exercises. Final delivery of the final software application is one week after the end of the lecture period. The oral exam take place in the second or third week after the end of the lecture period. Any re-examinations take place at the end of the semester break. The exact timetable can be found in the learning management system.	practical exercises and oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf113 - Operating Systems II

Module label	Operating Systems II
Module code	inf113
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Theel, Oliver (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)

Prerequisites

The module conveys an understanding of the terminology, structure, functionality, conception, core problems and essential solution concepts of operating systems. The students should then 1) be able to assess what an operating system does, 2) know where the problems lie in the realisation of operating systems, 3) know, apply and evaluate common realisations of sub-problems and 4) be able to transfer the realisation concepts to other contexts. The following contents will not be discussed further and their knowledge is assumed:

1. Explanation of the term ``operating system'', structural organisation
2. Requirements of an operating system
3. Properties of the underlying hardware
4. Necessity and realisation possibilities of parallel processes
5. Co-operation of processes: Communication and synchronisation (sempahore)
6. Memory management: virtual and non-virtual main memory management

Skills to be acquired in this module

The aim of the module "Operating Systems 2" is to convey further knowledge and skills regarding the conception, implementation, and evaluation of operating systems.

Professional competence:
The Students:

- assess in detail what an operating system is able do
- recognize the problems in the implementation of operating systems
- identify and evaluate implementations of further subproblems and apply them

Methodological competence:
The Students:

- transfer implementation concepts to other contexts
- critically question different solutions with regard to their properties

Social competence:
The Students:

- solve problems partly in small groups
- present own potential solutions to the exercise group
- discuss their different potential solutions within the exercise group

Self-competence:
The Students:

- accept criticism
- reflect their own potential solutions taking into account the methods taught

Module contents

The module conveys the following contents:

1. additional aspects of file systems
2. Input/output control
3. User representation
4. Advanced synchronization concepts
5. User interfaces
6. Job scheduling
7. Architectures of operating systems
8. Examples of operating systems

Recommended reading	• A. Tanenbaum. Modern Operating Systems. Prentice Hall, Most recent edition • W. Stallings.Operating Systems. Prentice Hall, most recent edition • J.Nehmer (2001) Systemsoftware • Grundlagen moderner Betriebssysteme, dpunkt-verlag
Links	
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	Alle 2 Jahre
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture term	written or oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf131 - Advanced Topics in Human Computer Interaction

Module label	Advanced Topics in Human Computer Interaction
Module code	inf131
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Computing Science (Master) > Praktische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction
Responsible persons	• Boll-Westermann, Susanne (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Useful previus knowledge: Interactive Systems

Skills to be acquired in this module

This course aims to provide a sample of some of the most recent and significant advances in this exciting area. Topics may include: situational awareness, designing for attention, ambient/peripheral interaction, computer support cooperative work and social computing (CSCW), ubiquitous and context-aware computing, haptic and gestural interaction, audio interaction, gaze-based interaction, biometric interfaces, and embedded, physical and tangible computing, mobile and wearable interfaces.
This course is explicitly not focused on the methods used in HCI practice (i.e., user-centered design cycle), but rather focuses on (recent) research.

Professional competences
The students:

- demonstrate a systematic understanding of knowledge and critical awareness of a selection of the recent research advances in the area of HCI
- valuate and critique recent developments in the field of HCI on scientific and technological grounds
- develop ability to conceptualize, design, implement, and evaluate user-centered systems and techniques.
- plan an implement exploratory projects directed at envisioning and prototyping novel interactive artifacts

Methodological competences
The students:

- analyze, review and critique research papers
- carry out original research from start to finish
- summarize and present research findings
- work in a team to produce and evaluate prototypes of novel interactive artifact

Social competences
The students:

- work collaboratively in groups to analyze and review research papers
- summarize and present research findings to rest of class
- discuss how HCI concepts and methods can be applied in analysis, design, and evaluation of interactive technologies.
- discuss social and ethical implications of interactive technologies

Self-competences
The students:

- are comfortable tackling original research questions
- show aptitude in conceptualizing and running both qualitative and quantitative HCI experiments
- acquire the ability to summarize, analyze, and critique published (peer-

review) research papers

Module contents	HCI is a fast-growing field, where scientific research in this area crosses multiple disciplines. The body of theoretical and empirical knowledge that can inform the design of effective systems is rapidly developing, which underscores the importance of current research in the field. This course aims to provide a sample of some of the most recent and significant advances in this exciting area. Topics may include: situational awareness, designing for attention, ambient/peripheral interaction, computer support cooperative work and social computing (CSCW), ubiquitous and context-aware computing, haptic and gestural interaction, audio interaction, gaze-based interaction, biometric interfaces, and embedded, physical and tangible computing, mobile and wearable interfaces. The course will consist of lectures and lab sessions. Lab sessions will cover assignments (writing paper reviews, presentations, and peer assessment). In addition to assignments and a final exam, a small part of the course includes a mini group-based HCI project.
Recommended reading	• The Computer for the 21st Century, Mark Weiser, Scientific American, September 1991, pp. 94 - 104. • Bush, V. (1945). As We May Think. Atlantic Monthly. Design of Everyday Things, Chapters 1 to 7 • Greenberg, S. and Buxton, B. (2008). Usability Evaluation Considered Harmful (Some of the Time). Proceedings of the ACM Conference on Human Factors in Computing Systems (CHI 2008), 111-120. • Olsen, D.R. (2007). Evaluating User Interface Systems Research. Proceedings of the ACM Symposium on User Interface Software and Techno
Links	https://uol.de/en/media-informatics/teaching/courses

Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	every winter term
Module capacity	24
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module	At the end of the lecture period	Project and oral exam Missing the exam If you cannot attend the exam with valid reasons (medical reason, exam schedule conflicts), you need to inform us before the exam, and submit a scanned copy of the evidence (medical certificate, course registration, boarding passes) within 5 days after the exam. • If the reason for missing the exam is valid, you will do your first try of the exam for the parts that you missed on the same date as the second chance exam. • If the reason is not valid, you will not get any score from that exam. If your overall score passed the course, you will not have a chance to take the exam again.

Examination	Prüfungszeiten	Type of examination
		Grading: Your grade will be calculated as follows: Scored Items % Final 40 Assignments A01–03 20 Mini HCI research project 40

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf170 - Special Topics in 'Information Systems' I

Module label	Special Topics in 'Information Systems' I
Module code	inf170
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Grawunder, Marco (module responsibility) • Wingerath, Wolfram (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements

Skills to be acquired in this module

This module integrates current developments in the field in adequate study courses.

Professional competences
The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences
The students:

- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

Social competences
The students:

- support team process by their abilities

Self-competences
The students:

- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

Module contents	According to the assigned course
Recommended reading	As announced in course
Links	
Languages of instruction	German, English

Duration (semesters)	1 Semester
Module frequency	unregelmäßig
Module capacity	unlimited
Teaching/Learning method	events from V, S, Ü, P, PR

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Written exam or portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf171 - Special Topics in 'Information Systems' II

Module label	Special Topics in 'Information Systems' II
Module code	inf171
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Grawunder, Marco (module responsibility) • Wingerath, Wolfram (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	According to the assigned course
Recommended reading	will be announced in the assigned course
Links	
Languages of instruction	German, English

Duration (semesters)	1 Semester
Module frequency	unregelmäßig
Module capacity	unlimited
Teaching/Learning method	events from V, S, Ü, P, PR

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Written exam or Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf172 - Current Topics in 'Information Systems' I

Module label	Current Topics in 'Information Systems' I
Module code	inf172
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Grawunder, Marco (module responsibility) • Wingerath, Wolfram (module responsibility) • der Informatik, Lehrende (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • Define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • Recognise and evaluate applied techniques and methods of their subject and are aware of their limits • Identify, structure and solve problems/tasks, also in new or developing subject areas • Apply state of the art and innovative methods to solve problems, if necessary from other disciplines • Are aware of the current limits and contribute to the development of computer science research and technology • Discuss and evaluate recent computer science developments • **Methodological competences** The students: • Examine tasks with technical and research literature, write an academic article and present their solutions academically • Evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • Communicate with users and experts convincingly **Self-competences** The students: • Pursue the overall and special computer science development critically • Develop and reflect self-developed hypotheses to theories independently
Module contents	According to the assigned course
Recommended reading	will be announced in the assigned course
Links	
Languages of instruction	German, English

Duration (semesters)	1 Semester
Module frequency	unregelmäßig
Module capacity	unlimited
Teaching/Learning method	V or S

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Written Exam or Portfolio or Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf173 - Current Topics in 'Information Systems' II

Module label	Current Topics in 'Information Systems' II
Module code	inf173
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Grawunder, Marco (module responsibility) • Wingerath, Wolfram (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	According to the assigned course
Recommended reading	will be announced in the assigned course
Links	
Languages of instruction	German, English

Duration (semesters)	1 Semester	
Module frequency	unregelmäßig	
Module capacity	unlimited	
Teaching/Learning method	V or S	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Written Exam or Portfolio or Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering

inf174 - Special Topics in 'Media Informatics and Multimedia Systems' I

Module label	Special Topics in 'Media Informatics and Multimedia Systems' I
Module code	inf174
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Praktische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction
Responsible persons	• Boll-Westermann, Susanne (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	The aim of the module is to integrate the latest developments in the field of “Media Informatics and Multimedia Systems” appropriately into a course of study. **Professional competences** The students: • define and contrast special themes in computer science, and reflect on computer science practices in general. • recognize and evaluate applied techniques and methods and their limits • identify, structure and solve problems/tasks, in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • recognize current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods and utilize them appropriately • combine new and original approaches and methods creatively • reflect on problems/tasks, including new or developing subject areas in their discipline and apply computer science methods for investigation and resolution **Social competences** The students: • integrate their skills in a team environment. **Self-competences** The students: • pursue the further development of computer science in general and in this particular sub-field critically • innovatively conduct professional activities effectively and independently
Module contents	According to the assigned course
Recommended reading	will be announced in the assigned course
Links	

	https://uol.de/en/media-informatics/teaching/courses

Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	irregulary
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Portfolio or Presentation or Oral Exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	see frequency of module offering	28
Exercises		2	see frequency of module offering	28
Total module attendance time				56 h

inf175 - Special Topics in 'Media Informatics and Multimedia Systems' II

Module label	Special Topics in 'Media Informatics and Multimedia Systems' II
Module code	inf175
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Praktische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction
Responsible persons	• Boll-Westermann, Susanne (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements

Skills to be acquired in this module

The aim of the module is to integrate the latest developments in the field of “Media Informatics and Multimedia Systems” appropriately into a course of study.

Professional competences
The students:

- define and contrast special themes in computer science, and reflect on computer science practices in general.
- recognize and evaluate applied techniques and methods and their limits
- identify, structure and solve problems/tasks, in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- recognize current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences
The students:

- evaluate and apply tools, technology and methods and utilize them appropriately
- combine new and original approaches and methods creatively
- reflect on problems/tasks, including new or developing subject areas in their discipline and apply computer science methods for investigation and resolution.

Social competence
The students:

- integrate their skills into team processes

Self-competences
The students:

- pursue the further development of computer science in general and in this particular sub-field critically.
- innovatively conduct professional activities effectively and independently.

Module contents

According to the assigned course

Recommended reading

Literature will be announced in the assigned course

Links

https://uol.de/en/media-informatics/teaching/courses

Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	irregulary
Module capacity	unlimited
Teaching/Learning method	events from V, S, Ü, P

Examination	Prüfungszeiten	Type of examination
Final exam of module	At the end of the lecture period	Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf176 - Current Topics in 'Media Informatics and Multimedia Systems' I

Module label	Current Topics in 'Media Informatics and Multimedia Systems' I
Module code	inf176
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Boll-Westermann, Susanne (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	The aim of the module is to integrate the latest developments in the field of "Media Informatics and Multimedia Systems" appropriately into a course of study. **Professional competences** The students: • define, differentiate, and contrast special themes in computer science, and reflect on computer science practices in general • recognize and evaluate applied techniques and methods and their limits • identify, structure and solve problems in new or emerging areas of their discipline • apply appropriate and innovative methods to the state of the art in the investigation and resolution of problems, possibly with recourse to other disciplines • recognize the limitations of existing knowledge and technology practices and contribute to the further scientific and technological development of computer science • discuss current developments in computer science and assess their significance **Methodological competences** The students: • investigate problems based on technical and scientific literature, compose an article according to scientific criteria, and present their results in a scientific lecture • reflect on problems in new or emerging areas of their discipline and apply computer science methods for investigation and resolution • do scheduling and planning of resources **Social competences** The students: • communicate effectively verbally and in writing with users and experts **Self-competences** The students: • critically pursue the further development of computer science in general and this particular sub-field • develop and reflect on their own theories and independent hypotheses
Module contents	According to the assigned course
Recommended reading	will be announced in the assigned course
Links	

	https://uol.de/en/media-informatics/teaching/courses
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	V or S

Examination	Prüfungszeiten	Type of examination
Final exam of module	At the end of the lecture period	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf177 - Current Topics in 'Media Informatics and Multimedia Systems' II

Module label	Current Topics in 'Media Informatics and Multimedia Systems' II
Module code	inf177
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Boll-Westermann, Susanne (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	The aim of the module is to integrate the latest developments in the field of "Media Information and Multimedia Systems" into a course of study. **Professional competences** The students: • define, differentiate, and contrast special themes in computer science, and reflect on computer science practices in general. • recognize and evaluate applied techniques and methods and their limits • identify, structure, and solve problems in new or emerging areas of their discipline • apply appropriate and innovative methods to the state of the art in the investigation and resolution of problems, possibly with recourse to other disciplines • recognize the limitations of existing knowledge and technology practices and contribute to the further scientific and technological development of computer science • discuss current developments in computer science and assess their significance **Methodological competences** The students: • investigate problems based on technical and scientific literature, compose an article according to scientific criteria, and present their results in a scientific lecture • reflect on problems in new or emerging areas of their discipline and apply computer science methods for investigation and resolution • do scheduling and planning of resources **Social competences** The students: • communicate effectively verbally and in writing with users and experts **Self-competences** The students: • critically pursue the further development of computer science in general and this particular sub-field • develop and reflect on their own theories and independent hypotheses
Module contents	According to the assigned course
Recommended reading	will be announced in the assigned course
Links	

	https://uol.de/en/media-informatics/teaching/courses
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	V or S

Examination	Prüfungszeiten	Type of examination
Final exam of module	At the end of the lecture period	Presentation or oral exam.

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf178 - Special Topics in 'Software Engineering' I

Module label	Special Topics in 'Software Engineering' I
Module code	inf178
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Winter, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	The module aims to integrate current developments in the specialization area of **software engineering** into the course of study in the appropriate course forms. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	See the assigned course description
Recommended reading	Will be announced in the assigned course
Links	
Language of instruction	German

Duration (semesters)	1 Semester
Module frequency	unregelmäßig
Module capacity	unlimited
Teaching/Learning method	events from V, S, Ü, P

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf179 - Special Topics in 'Software Engineering' II

Module label	Special Topics in 'Software Engineering' II
Module code	inf179
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Winter, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	The module aims to integrate current developments in the field of specialization "Software Engineering" into the course of study in the appropriate course forms. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	See the assigned course description
Recommended reading	As announced in course

Links		
Language of instruction		German
Duration (semesters)		1 Semester
Module frequency		irregular
Module capacity		unlimited
Teaching/Learning method		events from V, S, Ü, P
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf180 - Current Topics in 'Software Engineering' I

Module label	Current Topics in 'Software Engineering' I
Module code	inf180
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Winter, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course description
Recommended reading	Will be announced in the assigned course
Links	
Language of instruction	German

Duration (semesters)	1 Semester
Module frequency	unregelmäßig
Module capacity	unlimited
Teaching/Learning method	V or S

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf181 - Current Topics in 'Software Engineering' I

Module label	Current Topics in 'Software Engineering' I
Module code	inf181
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Winter, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks withechnical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** • The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course description
Recommended reading	Will be announced in the assigned course
Links	
Language of instruction	German
Duration (semesters)	1 Semester

Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	V or S	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture periode	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf182 - Special Topics in 'System Software and Distributed Systems' I

Module label	Special Topics in 'System Software and Distributed Systems' I
Module code	inf182
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Theel, Oliver (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	According to the assigned course, e.g. „Verteilte Systeme“, „Realzeitbetriebssysteme“ or „Drahtlose Rechnernetze“
Recommended reading	As announced in course
Links	
Language of instruction	German

Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	events from V, S, Ü, P

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf183 - Special Topics in 'System Software and Distributed Systems' II

Module label	Special Topics in 'System Software and Distributed Systems' II
Module code	inf183
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Theel, Oliver (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	According to the assigned course, e.g. „Verteilte Systeme“, „Realzeitbetriebssysteme“ or „Drahtlose Rechnernetze“
Recommended reading	Will be announced in the assigned course
Links	
Language of instruction	German

Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	events from V, S., Ü, P

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf184 - Current Topics in 'System Software and Distributed Systems' I

Module label	Current Topics in 'System Software and Distributed Systems' I
Module code	inf184
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Theel, Oliver (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course description
Recommended reading	Will be announced in the assigned course
Links	
Language of instruction	German

Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	V or S

Examination	Prüfungszeiten	Type of examination
Final exam of module		
		Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf185 - Current Topics in 'System Software and Distributed Systems' II

Module label	Current Topics in 'System Software and Distributed Systems' II
Module code	inf185
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Theel, Oliver (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** • The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course description
Recommended reading	Will be announced in the assigned course
Links	
Language of instruction	German

Duration (semesters)	1 Semester
Module frequency	unregelmäßig
Module capacity	unlimited
Teaching/Learning method	V or S

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf189 - Special Topics in Practical Computer Science I

Module label	Special Topics in Practical Computer Science I
Module code	inf189
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Peter, Andreas (module responsibility) • Vogel-Sonnenschein, Ute (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	The required prerequisites are further specified in the details of the assigned course.

Skills to be acquired in this module

The module aims to integrate current developments in the field of Practical Informatics into the course of study in the appropriate course forms.

Professional competences
The students:

- differentiate and contrast a subarea of practical computer science in more detail
- recognize and assess the techniques and methods to be applied in the special field of the course and their limits
- identify, structure and solve problems also in new or emerging areas of their discipline
- recognize the limits of current knowledge and technology and contribute to the further scientific and technological development of computer science
- discuss current developments in practical computer science and assess their significance
- critically follow further developments in the special field discussed in the course.

Methodological competences
Students will:

- apply state-of-the-art and innovative methods in the reserarch and solution of problems, drawing on other disciplines where appropriate
- investigate problems on the basis of technical and scientific literature,
- write an article according to scientific criteria, and present their results in a scientific talk
- reflect on problems, including those in new or emerging areas of practical computer science, and apply computer science methods to investigate and solve them
- plan time schedules and other resources
- develop and reflect on their own theories on independently generated hypotheses

Social competences
Students will:

- communicate persuasively orally and in writing with users and professionals
- solve tasks goal-oriented in a team

Self competences
The students

- deepen their self-organization skills
- reflect self-critically on their actions and skills in the special field under consideration and assess them appropriately

Module contents

	In this module, content and methods on current topics in practical computer science are taught. For details on objectives and contents, please refer to the details of the assigned course or contact the lecturers directly
Recommended reading	
	Will be announced in the assigned course
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Reference text	
	see course description for more details
Teaching/Learning method	events from V, S. Ü, P

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	Portfolio and presentation (Referat) : during the course Written or oral exam: At the end of the lecture period. More detailed information on the forms of examination will be given in the course.	Written exam or portfolio or presentation (Referat) or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf191 - Special Topics in Practical Computer Science II

Module label	Special Topics in Practical Computer Science II
Module code	inf191
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Peter, Andreas (module responsibility) • Vogel-Sonnenschein, Ute (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	The module aims to integrate current developments in the field of Practical Informatics into the course of study in the appropriate course forms. **Subject competences** The students: • differentiate and contrast a subarea of practical computer science in more detail • recognize and assess the techniques and methods to be applied in the special field of the course and their limits • identify, structure and solve problems also in new or emerging areas of their discipline • recognize the limits of current knowledge and technology and contribute to the further scientific and technological development of computer science • discuss current developments in practical computer science and assess their significance • critically follow further developments in the special field discussed in the course. **Methodological competencies** The Students: • apply state-of-the-art and innovative methods in the reserarch and solution of problems, drawing on other disciplines where appropriate • investigate problems on the basis of technical and scientific literature, • write an article according to scientific criteria, and present their results in a scientific talk • reflect on problems, including those in new or emerging areas of practical computer science, and apply computer science methods to investigate and solve them • plan time schedules and other resources • develop and reflect on their own theories on independently generated hypotheses **Social Skills** The Students: • will communicate persuasively orally and in writing with users and professionals • will solve tasks goal-oriented in a team **Self-competencies** The students: • deepen their self-organization skills • reflect self-critically on their actions and skills in the special field under consideration and assess them appropriately
Module contents	In this module, content and methods on current topics in practical computer science are taught.

	For details on objectives and contents, please refer to the details of the assigned course or contact the lecturers directly
Recommended reading	depending on the course assigned
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	events of V, Ü, S, P

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	Am Ende der Vorlesungszeit nach Absprache mit dem Lehrenden	Fachpraktische Übungen oder Referat oder mündliche Prüfung

Type of course	Course selection
SWS	2
Frequency	see frequency of module offering
Workload attendance time	56 h

inf334 - System Level Design

Module label	System Level Design
Module code	inf334
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Praktische Informatik • Master's Programme Computing Science (Master) > Technische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Klös, Verena (module responsibility) • Boll-Westermann, Susanne (module responsibility) • Peter, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements

Skills to be acquired in this module

Professional competences
The students:

- ability to describe and analyze system components and architectures using system level description languages SpecC and SystemC
- capabilities for partitioning and parallelizing of applications

Methodological competences
The students:

- knowledge of refinement and transformation techniques for transferring an initial specification into a real implementation
- knowledge of the phases of a system-level design flow
- nowledge of current design methods and tools in system level design
- knowledge about formal models of computation of specification languages
- knowledge of current research results and trends in system level design
- capabilities for partitioning and parallelizing of applications
- ability to evaluate and explore design decisions
- ability to implement a complete system design-to-implementation specification

Social competences
The students:

- implement solutions of given problems in teams
- discuss their outcomes appropriately

Self-competences
The students:

- presentation skills
- reflect their solutions by using methods learned in this course

Module contents

The ever-increasing integration densities of integrated circuits enable the implementation of increasingly powerful and complex systems. This can be on the one hand the integration of several sub-components on the same chip (system-on-chip) or on the other hand the implementation of more powerful algorithms. However, traditional design techniques are hardly able to cope with the increasing complexity of today's embedded systems. Therefore, in research and practice efforts through new methods and tools, there is a significant increase in productivity in the design process, thus closing the so-called "design productivity gap". This is achieved, for example, by a stronger abstraction, in which the behavior of components is described only at the

	algorithmic level and is automatically translated into hardware or software implementations by high-level synthesis techniques. The final system implementation is achieved by means of a structured refinement and exploration processes. Throughout this refinement flow, system properties (for example, timing, energy consumption, chip area and costs) are estimated on each abstraction level and guide the designer in the iterative decision process. By means of techniques such as virtual prototyping, entire systems can be simulated and verified on each refinement layer, even without the availability of a full implementation for all system components. This module builds on the modules Embedded Systems I and II, deepens the knowledge acquired there for the design of hardware/software systems and expands them with current methods and tools. With SystemC, a language is presented that is already widely used in industry and research for the design and verification of hardware/software systems and supports several abstraction levels from clock cycle accurate hardware description, over transaction level models to process based functional specifications.

Recommended reading

Suggested reading:
Main textbooks:

- D. Gajski, S. Abdi, A. Gerstlauer, G. Schirner, Embedded System Design: Modeling, Synthesis, Verification, Springer, 2009 (“orange book”)
- D. C. Black, J. Donovan, B. Bunton, A. Keist, SystemC: From The Ground Up, Second Edition, Springer 2010 (“red book”)

Optional books:

- F. Vahid, T. Givargis, Embedded System Design: A Unified Hardware/Software Introduction, Wiley, John & Sons, 2001 (“blue book”). Background about embedded systems in general
- A. Gerstlauer, R. Doemer, J. Peng, D. Gajski, System Design: A Practical Guide with SpecC, Kluwer, 2001 (“yellow book”). Practical, example-driven introduction using SpecC Additional reading material posted on Stud.IP

Links

https://www.uni-oldenburg.de/informatik/ehs/lehre/vorlesungen/system-level-design/

Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module	at the end of the lecture period	hands-on exercises and oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	28
Exercises		2	SuSe	28
Total module attendance time				56 h

inf420 - Introduction to IT-Security

Module label	Introduction to IT-Security
Module code	inf420
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Bachelor's Programme Business Informatics (Bachelor) > Akzentsetzungsbereich Praktische Informatik und Angewandte Informatik • Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik • Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Angewandte Informatik) • Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Theoretische Informatik) • Master of Education Programme (Hauptschule and Realschule) Computing Science (Master of Education) > Mastermodule • Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) > Akzentsetzungsbereich • Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Peter, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	
Skills to be acquired in this module	Students understand the basic concepts, methods and protocols for protecting data and systems from manipulation and misuse on a basic, practice-oriented, scientific level (see "contents of the module"). The students can explain the causes of security problems in today's systems, can reproduce the connections between protection mechanisms and the problems they address, and can apply them to case studies. They can identify vulnerabilities, analyze them and understand the attack mechanisms described. In addition, the students are able to discuss possible solutions and are able to protect systems accordingly. **Professional competence** The students • understand the semantics of security and explain the properties of secure IT systems (see "contents of the module"), • discuss the importance of IT security, and • carry out simple security analyses of systems. **Methological competence** The students • use concepts and techniques to increase security, in particular regarding which protection goals can be achieved with which techniques (see "contents of the module"), • apply mechanisms of IT security in simple scenarios, and • question the properties and limits of security concepts and combine different concepts in a meaningful way. **Social competence** The students • solve problems partially in small groups and thus improve their willingness to cooperate and their communication skills, • present solutions to IT security problems in front of the exercise group, • discuss their different solutions within the exercise group, and • improve their English language skills. **Self-competence** The students • motivate themselves to work on questions and problems in the domain of IT security, • justify their own actions with theoretical and methodical knowledge, and • critically reflect on proposed solutions in relation to social expectations and consequences, taking into account the methods taught.

Module contents

The course provides a broad introduction to IT security, covering the following topics:

- basic terms, concepts, and principles in IT security,
- major cryptographic building blocks (encryption, signatures, ...),
- access control models and mechanisms,
- authentication and key exchange protocols,
- network security basics,
- anonymous communication (including TOR), and
- basics of privacy protection.

Recommended reading

- C. Eckert. IT-Sicherheit: Konzepte – Verfahren – Protokolle. 10th edition. De Gruyter Oldenbourg, ISBN 978-3-110-58468-4, 2018
- P. van Oorschot. Computer Security and the Internet. 2nd edition. Springer, ISBN 978-3-030-83410-4, 2021
- R. Anderson. Security Engineering: A Guide to Building Dependable Distributed Systems. 2nd edition. Wiley, ISBN 978-0470068526, 2008

Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	Every winter semester
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		Written or oral exam The concretely chosen form of examination will be announced in the first week of the course.

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	2
Exercises		2	WiSe	2
Total module attendance time				4 h

inf1202 - Advanced Practical Course ‘Data Science’

Module label	Advanced Practical Course ‘Data Science’
Module code	inf1202
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Wingerath, Wolfram (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Basics of Databases, Basics of Data Science
Skills to be acquired in this module	The goals of this module are to acquire practical knowledge of data science and to relate it to questions from a concrete application domain. Furthermore, the students gain a sustainable insight into the technicalrealization, implementation, and content classification of data analysis processes and their results. **Professional competences** The students • have knowledge of technical implementation and programming of data analysis processes • pragram and implement processes in the context of data analysis (such as for automation or data cleaning). **Methological competences** The students • propose concrete processing principles for specific questions • reflect on certain technologies and procedures with regard to their effects on the results of data analyses **Social competences** The students • generate approaches for data analysis in a team **Self competences** The students • recognize their resilience in implementation and recognize errorsresults • reflect on their actions
Module contents	This module is primarily designed as a practical continuation of the module Data Science I. It deepens the content covered there through practical application in a concrete problem area. The module focuses on: • design of analyses to answer concrete questions from the given problem area • development (and cleaning) of relevant data sources • selection and application of appropriate concepts and techniques in conducting analyses • Interpretation and presentation of results
Recommended reading	See description of the assigned course

Links		
Languages of instruction	German, English	
Duration (semesters)	1 Semester	
Module frequency	annual	
Module capacity	unlimited	
Teaching/Learning method	P	

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	at the end of the lecture period or by arrangement with the instructor.	Portfolio or project or practical work or specialized practical exercises and oral examination

Type of course	Practical training
SWS	4
Frequency	SuSe or WiSe
Workload attendance time	56 h

inf1204 - Special topics from the field of ‘Data Science’

Module label	Special topics from the field of ‘Data Science’
Module code	inf1204
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Wingerath, Wolfram (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements

Skills to be acquired in this module

The module aims to integrate specific developments in the specialization area of "Data Science" into the course of study in the appropriate course forms.

Professional competences

The students

- differentiate and contrast in more detail a subfield of computer science in which they have specialized or reflect on computer science in general
- recognize and evaluate the techniques and methods to be used in their area of specialization and their limitations
- identify, structure, and solve problems also in new or emerging areas of their discipline
- apply state-of-the-art and innovative methods in investigating and solving problems, drawing on other disciplines as appropriate
- recognize the limits of current knowledge and technology and contribute to the further scientific and technological development of computer science
- discuss current developments in computer science and assess their significance

Methological competences
The students

- investigate problems using technical and scientific literature write an article according to scientific principles and present their results in a scientific talk
- reflect on problems, including those in new or emerging areas of their discipline, and apply computer science methods to investigate and solve them
- plan time schedules and other resources

Social competences

The students

- communicate persuasively orally and in writing with users and professionals

Self competences
The students

- critically follow further developments in computer science in general and in their special field
- develop and reflect on their own theories in relation to independently formulated hypotheses

Module contents

See description of the assigned course

Recommended reading		
	Will be announced in the course	
Links		
Language of instruction	German	
Duration (semesters)	1 Semester	
Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	events from V, Ü, S, P	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period or by arrangement with the instructor	Presentation or oral exam or portfolio or written exam

Type of course	Course selection
SWS	0
Frequency	see frequency of module offering

inf1206 - Hot topics from the field of ‘Data Science’ I

Module label	Hot topics from the field of ‘Data Science’ I
Module code	inf1206
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Wingerath, Wolfram (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	The module aims to integrate current developments in the specialization area of "Data Science" into the course of study in the appropriate course forms **Professional competences** The students • differentiate and contrast in more detail a subfield of the field of data science in which they have specialized or reflect on computer science in generall • recognize and evaluate the techniques and methods to be used in their area of specialization and their limitations • identify, structure, and solve problems also in new or emerging areas of their discipline • apply state-of-the-art and innovative methods in investigating and solving problems, drawing on other disciplines as appropriate • recognize the limits of current knowledge and technology and contribute to the further scientific and technological development of computer science • discuss current developments in computer science and assess their significance **Methological competences** The students • investigate problems using technical and scientific literature write an article according to scientific principles and present their results in a scientific talk • reflect on problems, including those in new or emerging areas of their discipline, and apply computer science methods to investigate and solve them • plan time schedules and other resources **Social competences** The students • communicate persuasively orally and in writing with users and professionals **Self competences** The students • critically follow further developments in computer science in general and in their special field • develop and reflect on their own theories in relation to independently formulated hypotheses
Module contents	See description of the assigned course

Recommended reading	
	Will be announced in the course

Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	V or S

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period or by arrangement with the instructor	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf1210 - Practical multimodal-multisensor data analysis pipelines

Module label	Practical multimodal-multisensor data analysis pipelines
Module code	inf1210
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Sonntag, Daniel (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Basic familiarity with Python and machine learning concepts
Skills to be acquired in this module	• review the current literature on multimodal-multisensor data analysis • identify unexplored research topics • recognize good practices and practical aspects of all steps in the data analysis process • gain hands-on experience on multimodal-multisensor data analysis pipelines **Professional competence** The students: • recognize the basic concepts of data analysis • identify the basic steps of data analysis pipelines **Methological competence** The students: • clean data based on the principles of tidy data • visualize data using different libraries and frameworks • identify relevant data questions and implement machine learning models • apply version control to data and models • design and implement a User Interface to interact with the data and models **Social competence** The students: • present their solutions to the group • discuss with each other different solution approaches to a given problem • review and discuss relevant research papers on data analysis **Self competence** The students: • acknowledge the limits of their ability to cope with approaching assignment deadlines • reflect on the limits of their ability to structure their project workload
Module contents	Multimodal-multisensor data is profoundly different from past data sources. It is extremely rich and dense data that typically involves multiple time-synchronized data streams, and it also can be analyzed at multiple levels such as signal, activity pattern, representational, transactional, etc. When multimodal-multisensor data are analysed at multiple levels, they constitute a vast multi-dimensional space for discovering important new phenomena with applied artificial intelligence methods. This course focusses on Data Analysis Pipelines and covers good practices and practical aspects of all steps in the process: handling file input, organising a project's code, transforming the data with spectral andmachine learning methods, and generating models and visualisations that capture relevant

structure in the data.

Recommended reading		
Links		
Languages of instruction		German, English
Duration (semesters)		1 Semester
Module frequency		every winter term
Module capacity		unlimited
Teaching/Learning method		V+Ü or S+Ü
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	at the end of the lecture period	oral examination or practical work or term paper

Type of course	Seminar
SWS	0
Frequency	SuSe or WiSe
Workload attendance time	4 h

inf1212 - Designing Explainable Artificial Intelligence

Module label	Designing Explainable Artificial Intelligence
Module code	inf1212
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Praktische Informatik
Responsible persons	• Sonntag, Daniel (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	• Basic knowledge in Artificial Intelligence/Machine Learning • Interest in the scientific development and evaluation of IT artifacts, which goes hand in hand with literature work • Willingness to deal with qualitative and/or quantitative evaluation methods • Interest in prototyping Recommended prior knowledge: • Basic knowledge of artificial intelligence and/or relevant programming skills (e.g., Python) • Familiarity with software for the design of prototypical information systems (e.g., for user interfaces)
Skills to be acquired in this module	• Become acquainted with the research field of Explainable Artificial Intelligence (XAI) • Become acquainted with different methods and techniques from the field of Explainable Artificial Intelligence (XAI) as well as their characteristics • Hands-on experience creating XAI systems **Professional competence** The students: • identify the basic concepts of Explainable Artificial Intelligence (XAI) **Methological competence** The students: • apply different methods and techniques from the field of Explainable • artificial Intelligence (XAI) and recognize their characteristics **Social competence** The students: • present their solutions to the group • discuss with each other different solution approaches to a given problem • review and discuss relevant literature **Self competence** The students: • acknowledge the limits of their ability to cope with approaching assignment deadlines • reflect on the limits of their ability to structure their project workload
Module contents	This course combines theoretical foundations from the field of Explainable Artificial Intelligence (XAI) with practical implementations for real-world problems. This includes: • communicating the status quo on the topic of Explainable Artificial Intelligence (XAI) and relevant use cases, stakeholders and research

opportunities
- instantiating possible solutions
- using qualitative and/or quantitative research methods for the evaluation of possible solutions
- working on (inter)disciplinary questions with high relevance for research and practice

Recommended reading		
Links		
Language of instruction	English	
Duration (semesters)	1 Semester	
Module frequency	every summer term	
Module capacity	unlimited	
Teaching/Learning method	V+Ü	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	at the end of the lecture period	practical work or term paper

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe or WiSe	28
Seminar		2	SuSe or WiSe	28
Total module attendance time				56 h

Technische Informatik

inf300 - Hybrid Systems

Module label	Hybrid Systems
Module code	inf300
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik • Master's Programme Computing Science (Master) > Theoretische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Fränzle, Martin Georg (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	
Skills to be acquired in this module	The module gives an introduction to hybrid discrete-continuous systems, as arising by embedding digital hardware into physical environments, and it elaborates on state of the art methods for the mathematical modelling and the analysis of such systems. It thus provides central competences for understanding and designing reliable cyber-physical systems. **Professional competence** The students: • characterise formal models of cyber-physical systems: hybrid automata, hybrid state transition systems • name domain-specific system requirements: safety, stability, robustness • name analysis methods: symbolic state-space exploration, abstraction and abstraction refinement, generalized Lyapunov-Methods • use state-of-the-art analysis tools • select and apply adequate modelling and analysis methods for concrete application scenarios • apply methods to reduce large state spaces and reduce infinite-state systems by abstraction • know the de-facto industry standards for system modelling and are able to apply the corresponding modelling framewortks and tools **Methodological competence** The students: • mtdel heterogeneous dynamical systems with adequate modelling and design tools, in particular Simulink/Stateflow • transfer modelling and analysis methods to other heterogeneous domains, e.g. socio-technical systems **Social competence** The students: • work in teams • solve complex modelling, design, and analysis tasks in teams **Self-competence** The students: • reflect their actions and respect the scope of methods dedicated to hybrid systems
Module contents	Embedded computer systems continuously interact with their environment, which generally comprises state- and time-continuous components.The coupling of the embedded system to its environment thus induces complex interleavings between discrete computational and decision processes and

	continuous processes. The resulting processes are neither amenable to the analytic techniques of continuous control nor of discrete mathematics. They instead require a broader, integrated theory: hybrid discrete-continuous systems.The lectures provide an in-depth introduction into a variety of analysis and design methods of these computer-based systems and their recent extensions to cyber-physical systems The accompanying hands-on-project enhances the lecture by developing and using design and verification tools.
Recommended reading	• Luca P Carloni, Roberto Passerone, Allesandro Pinto & Alberto L Sangiovanni-Vincentelli: Languages and Tools for Hybrid System design.World Scientific, 2006. • Wassim M. Haddad, VijaySekhar Chellaboina & Sergey G. Nersesov: Impulsive and Hybrid Dynamical Systems: Stability, Dissipativity, and Control. Princeton University Press, 2006 • Daniel Liberzon: Switching in Systems and Control. Birkhauser, 2003 • Michael Huth, Mark Ryan: Logic in Computer Science: Modelling and Reasoning About Systems. Cambridge University Press, 2004. • Christel Baier, Joost-Pieter Katoen: Principles of Model Checking. MIT Press, 2008.
Links	
Languages of instruction	English , German
Duration (semesters)	1 Semester
Module frequency	every summer term
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Semester project including written work and final presentation

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		3	SuSe	42
Exercises		1	SuSe	14
Total module attendance time				56 h

inf301 - Machine-oriented Systems Engineering

Module label	Machine-oriented Systems Engineering
Module code	inf301
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Fränzle, Martin Georg (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	The module provides practical relevance to the design of digital embedded systems. **Professional competence** The students: • characterise the structure of microprocessor systems • name control aspects of time sensitive external components • program efficient embedded systems **Methodological competence** The students: • use specifications from electrical components data sheets **Social competence** The students: • work in a team • discuss solutions
Module contents	Embedded systems support complex feedback problems, control problems and data processing tasks. They have an important value creation potential for telecommunications, production management, transport and electronics. The functionality of embedded systems is realised by the integration of processors, special hardware and software. The embedded systems design is influenced by the heterogeneity of system architectures, the complexity of systems and technical and economic requirements. This module gives an initial review of computer architectures. After that embedded systems are introduced by a specific microprocessor. Furthermore, external hardware will be connected to the microprocessor. Besides this, the design of circuit boards will be discussed. The students will design, develop and implement a circuit layout with CAD and programme this embedded system with a Flash-eprom.
Recommended reading	Lecturers notes, hardware manuals and data sheets, and development tool manuals
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester

Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+P

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Portfolio (Design, development and implementation of embedded systems, colloquium)

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Practical training		2	WiSe	28
Total module attendance time				56 h

inf303 - Fuzzy Control and Artificial Neural Networks in Robotics and Automation

Module label	Fuzzy Control and Artificial Neural Networks in Robotics and Automation
Module code	inf303
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Computing Science (Master) > Technische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Fatikow, Sergej (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	
Skills to be acquired in this module	Experts in different branches try to approach their application-specific control and information processing problems by using fuzzy logic and artificial neural networks (ANN). The experiences gathered up to now prove robotics and automation technology to be predestined fields of application of both these approaches. The major topics of the course are control problems in robotics and automation technology, principles of fuzzy logic and ANN and their practical appplications, comparison of conventional and advanced control methods, combination of fuzzy logic and ANN in control systems. The course gives a comprehensive treatment of these advanced approaches for interested students. **Professional competence** The students: • recognise control problems in robotics and automation technology, • name principles of fuzzy logic and ANN and their practical appplications, • compare conventional and advanced control methods, - characterise the combination of fuzzy logic and ANN in control systems **Methodological competence** The students: • will acquire knowledge of the tools, methods and applications in fuzzy logic and ANN • deepen their knowledge for the practical use of the given methods • can use common software tools for design and application of fuzzy logic and ANN **Social competence** The students: • gain experience in interdisciplinary work • are integrated into the recent research work Objective of the module / skills: **Self-competence** The students: • are able to transfer the gained knowledge for later use in their theses or studies for AMiR • can Design (complex) fuzzy logic controller and ANN systems • reflect their (control) solutions by using methods learned in this course
Module contents	• Control problems in robotics and automation technology • Basic ideas of fuzzy logic and ANN • Principles of fuzzy logic • Fuzzy logic of rule-based systems • ANN models

- ANN learning rules
- Multilayer perceptron networks and backpropagation
- Associative networks
- Self-organizing feature maps
- PID design principles
- Design of fuzzy control systems
- Fuzzy logic application examples
- Design of ANN control systems
- ANN application examples
- Fuzzy + Neuro: principles and applications

Recommended reading	Lecture notes will be provided, to prepare for oral examination
Links	
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period until the beginning of the next semester	Hands-on-exercises and oral Exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		3	SuSe	42
Exercises		1	SuSe	14
Total module attendance time				56 h

inf305 - Medical Technology

Module label	Medical Technology
Module code	inf305
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Interdisziplinäre Module • Master's Programme Computing Science (Master) > Technische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Hein, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	useful knowledge in - Signal and Image Processing - Control Engineering
Skills to be acquired in this module	Professional competence The students: • Describe medical diagnosis and therapy methods • Understand the core concepts of computer-assisted medical interventions • Are aware of the basic concepts and legal conditions of the development of medical devices • Define the character of medical devices' software parts and implement them • Assess the complex interaction of medical products and patients • Get familiar with the development of medical products within a short period of time **Methodological competence** The students: • Recognise the interdisciplinary challenges and accordingly exchange information with other disciplines **Social competence** The students: • Present solutions for specific questions **Self-competence** The students: • reflect their solutions by using methods learned in this course
Module contents	• Medical areas and areas of application • Basic requirements for medical systems (hygiene, MPG, technical security, materials) Medical systems: • Functional diagnostics (ECG, EMG, EEG) • Imaging systems (CT, MRI, ultrasound, PET, SPECT) • Therapy equipment (Laser, RF, Microtherapy) • Signal processing / monitoring (cardiovascular, hemodynamic, respiratory, metabolic, cerebral) • Medical Informatics (HIS, DICOM, Telemedicine, VR, image

processing).

Recommended reading

essential:

- Kramme, R.: Medizintechnik. Verfahren, Systeme und Informationssysteme. Springer Verlag, 2002 (2. Auflage)
- Lecture slides
- recommended:
- Lehmann, Th.; Oberschelp, W.; Pelikan, E.; Pepges, R.: Bildverarbeitung in der Medizin. Springer Verlag, 1997
- Dugas, M.; Schmidt, K.: Medizinische Informatik und Bioinformatik. Springer Verlag, 2003

secondary literature:

- Taylor, R.H. et al.: Computer-Integrated Surgery. Technology and clinical Applikations. MIT Press, Cambridge, MA, 1996

Links	
Languages of instruction	English , German
Duration (semesters)	1 Semester
Module frequency	once a year
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture periode	Portfolio

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		3	WiSe	42
Exercises		1	WiSe	14
Total module attendance time				56 h

inf307 - Robotics

Module label	Robotics
Module code	inf307
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Interdisziplinäre Module • Master's Programme Computing Science (Master) > Technische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Hein, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	Professional competence The students: • Name and know the functions and applications of robot systems • Characterise the basic concepts to program robot systems • Differentiate between the interaction of mechanical, electrical and software components **Methodological competence** The students: • Define characteristics and components of robot systems for a specific application • Design and implement robot system sub-components • Design and parameterise simple control structures • Plan the application of robot systems and derive the requirements • Model electrical and mechanical systems • Develop and realise simple robot systems **Social competence** The students: • Solve robot systems problems in team work **Self-competence** The students: • Reflect their solutions in reference to robot system methods
Module contents	Integration in production plants / aims / subsystems • Architectures / classifications (classification of robots) • Robot components + Computer systems for programming -- PA-10 -- Lego Mindstorms • Basics of kinematics -- Coordinate transformation, homogeneous coordinates, Coordinate transitions -- Kinematic equation systems, transformation of vectors • Kinematic -- Joint types (manipulators) / Wheels, TCP -- Denavit-Hartenberg-Transformation -- Forward calculation -- Backward calculation • Sensors -- General properties of sensors, parameter -- Simple optical position sensors -- Inductive-, capacitive- und ultrasonic-sensors -- Distance sensors (laser scanner, triangulation sensors) -- Force sensors -- Sensor data preparation

- Planing / Regulation -- Overall regulation approach, terms, process- and control functions, PID-controller -- Planning concepts and approaches (On-Line, Off-Line), planning processes, construction and path planning - Actuators

Recommended reading	essential: • lecture nodes **recommended:** • Lüth, T.: Technische Multi-Agenten-Syteme. Hanser-Verlag, 1998. • Siegert, H.-J.; Bocionek, S.: Programmierung intelligenter Roboter. Springer Verlag, 1996. • Craig, J.J.: Introduction to Robotics: Mechanics and Control. Prentice Hall, 1989. • Juckenack, D.: Handbuch der Sensortechnik: Messen mechanischer Größen. Verlag moderne Industrie, Landsberg/Lech, 1989. • Jiang, X.; Bunke, H.: Dreidimensionales Computersehen (Gewinnung und Analyse von Tiefenbildern), Springer Verlag, 1997. **sekondary literature:** • Hommel, G.; Heiß, H.: Roboterkinematik. Bericht 1990-15 an der TU-Berlin. Muir, P.F.; Neuman, C.P.: Kinematic Modeling of Wheeled Mobile Robots. Journal of Robotic Sytemes, 4(2) 281-340, 1987.
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture periode	Portfolio: Hands-on exercises, report, and written or oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		3	SuSe	42
Exercises		1	SuSe	14
Total module attendance time				56 h

inf308 - Microrobotics II

Module label	Microrobotics II
Module code	inf308
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Interdisziplinäre Module • Master's Programme Computing Science (Master) > Technische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Fatikow, Sergej (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Participation in Microrobotics and Microsystems Engineering would be helpful
Skills to be acquired in this module	After having given an established introduction in the module “Microrobotics and Microsystem Technology” this lecture offers a further specialisation in microrobotics. Within the course, all relevant areas (among others the research topics of the division “Microrobotics and Control Engineering (AMiR)”) will be presented and analysed. The student will be provided with an insight into current research projects of AMiR and of other research institutes of microrobotics worldwide; here mainly the requirements of industry to microrobots will be discussed. The lecture will be enhanced by practical courses in the research laboratories of AMiR. **Professional competence** The students: • name and recognise the basic concepts of nanotechnology, in particular, micro- and nanorobotics approaches • differentiate the development, control and application of micro- and nanorobotics systems - implement and design application-specific mirco- and nanorobotics systems **Methodological competence** The students: • transfer their control engineering and image processing abilities on interdisciplinary problems • transfer their hands-on experience to develop controls and apllications of microrobotic systems on new tasks **Social competence** The students: • work in a team **Self-competence** The students: • reflect their problem-solving behaviour and use hands-on experience to develop, control and application of microrobotics
Module contents	• Smart and versatile microrobots; microactuators (piezo-, ferrofluid- and SMA-actuators) for microrobots; • real-time image processing in the micro world (SEM, optical microscopy); • micro force sensors and tactile sensors for microrobots; • microrobot control systems, e.g. neural networks and fuzzy logic; • haptic interface for the control of microrobots;

- neural speech interface for the control of microrobots;
- robot-based micro- and nanohandling (SEM, optical microscopy);
- applications: microassembly, nano-testing, cell handling;
- Micro Air Vehicles (MAVs); multi-robot systems: team behavior, communication, control issues

Recommended reading

- Lecture notes (can be obtained in secretariate, A1-3-303)
- Fatikow, Sergej (Ed.): Automated Nanohandling by Microrobots, Springer, London, 2008

Links	
Languages of instruction	English , German
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module	After the end of the module until the beginning of the next lecture period	Oral Exam and exercises

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		3	SuSe	42
Exercises		1	SuSe	14
Total module attendance time				56 h

inf311 - Low Energy System Design

Module label	Low Energy System Design
Module code	inf311
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Rauh, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	
Skills to be acquired in this module	This module introduces the estimation of power dissipation and optimisation. **Professional competence** The students: • Discuss the fundamental problems of power dissipation • Characterise the requirements-driven design process of embedded systems • Name power loss analysis and optimization methods • Design embedded systems with common design and analysis tools • Design power-optimized embedded systems **Methodological competence** The students: • Model systems with a hardware description language • Analyze and model hardware components • Perform multi-dimensional optimization of systems **Social competence** The students: • Implement solutions of given problems in teams • Discuss their outcomes appropriately **Self-competence** The students: • Acknowledge the limits of their ability to cope with pressure during the modeling process of systems
Module contents	According to Moore’s Law the number of integratable transistors on a computer chip doubles every two years. In addition, new circuits are getting faster and faster. This leads not only to an increased functionality of a system, but it also increases the electrical power consumption. This electrical power consumption is problematic from two different points of view: Firstly, the electrical power must be supplied. Secondly, the resulting heat has to dissipate from the system. An increased power consumption always causes lower battery life and higher energy costs. The heat generation reduces the reliability and life of integrated circuits. The cooling (ceramic housings, cooling elements, fans, etc.) increases the system's costs. Today the development of heat, caused by power dissipation, needs to be considered during the embedded system design process. This knowledge takes the system's reliability and operation costs into account. This module introduces the estimation of power dissipation and optimisation.
Recommended reading	• Designing CMOS Circuits for Low Power – Dimitros Soudris, Christian Piguet, Costas Goutis • Low-Power CMOS VLSI Circuit Design – Kaushik Roy, Sharat C. Prasad - Low-Power Electronics Design – Christian Piguet et al.

- Leakage in Nanometer CMOS Technologies – Siva G. Narendra, Anantha Chandrakasan
- Entwurf von digitalen Schaltungen und Systemen mit HDLs und FPGAs – F. Kesel, R. Bartholomä
- Slides of the module „Eingebettete Systeme I+II“ von Professor Dr.-Ing. Wolfgang Nebel
- Slides and technical readouts of the used hardware and development tools

Links	
Languages of instruction	English , German
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module	at the end of the lecture period	hands-on exercises and oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf331 - Automated and Connected Driving

Module label	Automated and Connected Driving
Module code	inf331
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
Responsible persons	• Köster, Frank (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	**useful knowledge in** - Computer Engineering, - Embedded Systems I, - Embedded Systems II
Skills to be acquired in this module	This module introduces the principles of automated driving. **Professional competences:** The stud The students: • discuss different levels of automated driving (eg. SAE-Level) and the differences • discuss different levels of connected driving and the differences • discuss core-domains of automated vehicles • discuss important technological pillars in the areas sense, plan, and act • discuss transition between different levels of automation • discuss the impact of connected vehicle functions on automated driving • discuss the impact of automated vehicle functions on connected driving • characterise the impact of automated and connected driving on road traffic • characterise the interaction of humans and automated and connected vehicles • design an abstract procedure for the change of different levels of automation • design a rough vehicle architecture for automated and connected drivingents: **Methodological competences:** The students: • analyze complex automated and connected vehicles (-> domains) • analyze core-functions of automated and connected vehicles (-> functions) **Social competences:** The students: • work in teams • discuss their outcomes appropriately **Self-competences:** The students: • acknowledge the limits of their ability to cope with pressure during the analysis of complex (automated and connected) socio-technical systems
Module contents	• levels of automated driving (eg. SAE-Level) • levels of connected driving - core-domains of automated vehicles • sense, plan, and act in the context of automated and connected vehicles • transition between different levels of automation • selected connected vehicle functions

- selected automated vehicle functions
- human factors and socio-technical systems
- vehicle architectures

Recommended reading	Suggested reading: • Maurer, M., Gerdes, J.C., Lenz, B., Winner, H. (Eds.) (2015). Autonomes Fahren (Technische, rechtliche und gesellschaftliche Aspekte), Springer (Open Access) • Braess, H.-H., Seiffert, U. (Eds.) (2012). Handbuch Kraftfahrzeugtechnik, Vieweg.
Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Praktical work or oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	28
Exercises		2	SuSe	28
Total module attendance time				56 h

inf332 - Practice Robotics

Module label	Practice Robotics
Module code	inf332
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
Responsible persons	• Hein, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	Professional competences The students learn: • programming of robots (mobile or stationary) • implementation of elementary operations • integration of operations into a small application scenario • programming using Robot Operating System (ROS) **Methodological competences** The students learn: • systematic development process with team members • systematic evaluation of the application • designing a robotic application using basic and advanced robotic concepts **Social competences** The students learn: • project management • team work • organization of the team **Self-competences** The students: • time management • autodidactic work (literature search, technical specs, related work)
Module contents	Robotic systems will be provided to the students. They will then define the project/application scenario of the robots by their own and complete the project as a small team with self-organization and work distribution among the team members. The module consists of a lecture and an exercise part: Lecture: 2-3 lectures for introduction onto the module and introduction into the Robot Operating System (ROS) as well as the concepts of the projects. Exercises: After the introduction period, the students will work self-organized to complete the proposed project. Work can be distributed weekly or on as concentrated time blocks.
Recommended reading	• John J. Craig, Introduction to Robotics: Mechanics and Control Patrick Goebel, ROS By Example
Links	
Language of instruction	English

Duration (semesters)	1 Semester	
Module frequency	annual	
Module capacity	unlimited	
Teaching/Learning method	V+Ü	

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Demonstration and written documentation

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe or WiSe	28
Exercises		2	SuSe or WiSe	28
Total module attendance time				56 h

inf334 - System Level Design

Module label	System Level Design
Module code	inf334
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Praktische Informatik • Master's Programme Computing Science (Master) > Technische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Klös, Verena (module responsibility) • Boll-Westermann, Susanne (module responsibility) • Peter, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements

Skills to be acquired in this module

Professional competences
The students:

- ability to describe and analyze system components and architectures using system level description languages SpecC and SystemC
- capabilities for partitioning and parallelizing of applications

Methodological competences
The students:

- knowledge of refinement and transformation techniques for transferring an initial specification into a real implementation
- knowledge of the phases of a system-level design flow
- nowledge of current design methods and tools in system level design
- knowledge about formal models of computation of specification languages
- knowledge of current research results and trends in system level design
- capabilities for partitioning and parallelizing of applications
- ability to evaluate and explore design decisions
- ability to implement a complete system design-to-implementation specification

Social competences
The students:

- implement solutions of given problems in teams
- discuss their outcomes appropriately

Self-competences
The students:

- presentation skills
- reflect their solutions by using methods learned in this course

Module contents

The ever-increasing integration densities of integrated circuits enable the implementation of increasingly powerful and complex systems. This can be on the one hand the integration of several sub-components on the same chip (system-on-chip) or on the other hand the implementation of more powerful algorithms. However, traditional design techniques are hardly able to cope with the increasing complexity of today's embedded systems. Therefore, in research and practice efforts through new methods and tools, there is a significant increase in productivity in the design process, thus closing the so-called "design productivity gap". This is achieved, for example, by a stronger abstraction, in which the behavior of components is described only at the algorithmic level and is automatically translated into hardware or software implementations by high-level synthesis techniques. The final system implementation is achieved by means of a structured refinement and exploration processes. Throughout this refinement flow, system properties (for example, timing, energy consumption, chip area and costs) are estimated on each abstraction level and guide the designer in the iterative decision process. By means of techniques such as virtual prototyping, entire systems can be simulated and verified on each refinement layer, even without the availability of a full implementation for all system components. This module builds on the modules Embedded Systems I and II, deepens the knowledge acquired there for the design of hardware/software systems and expands them with current methods and tools. With SystemC, a language is presented that is already widely used in industry and research for the design and verification of hardware/software systems and supports several abstraction levels from clock cycle accurate hardware description, over transaction level models to process based functional specifications.

Recommended reading

Suggested reading:
Main textbooks:

- D. Gajski, S. Abdi, A. Gerstlauer, G. Schirner, Embedded System Design: Modeling, Synthesis, Verification, Springer, 2009 (“orange book”)
- D. C. Black, J. Donovan, B. Bunton, A. Keist, SystemC: From The Ground Up, Second Edition, Springer 2010 (“red book”)

Optional books:

- F. Vahid, T. Givargis, Embedded System Design: A Unified Hardware/Software Introduction, Wiley, John & Sons, 2001 (“blue book”). Background about embedded systems in general
- A. Gerstlauer, R. Doemer, J. Peng, D. Gajski, System Design: A Practical Guide with SpecC, Kluwer, 2001 (“yellow book”). Practical, example-driven introduction using SpecC Additional reading material posted on Stud.IP

Links

https://www.uni-oldenburg.de/informatik/ehs/lehre/vorlesungen/system-level-design/

Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module	at the end of the lecture period	hands-on exercises and oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	28
Exercises		2	SuSe	28
Total module attendance time				56 h

inf336 - Application Area Automotive

Module label	Application Area Automotive
Module code	inf336
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Köster, Frank (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module introduces the application area Automotive. **Professional competences:** The students: • discuss core-concepts of the transportation domain • discuss different modes of transportation (focus on the automotive sector) • discuss automated and connected driving (short introduction/overview) • discuss human factors in the automotive sector • discuss traffic infrastructure (focus on intersections) • discuss basic principles in traffic management **Methodological competences:** The students: - • analyze vehicle systems • analyze traffic infrastructure • analyze cooperative vehicle/infrastructure systems • analyze socio-technical systems **Social competences:** The students: • work in teams • discuss their outcomes appropriately **Self-competences:** The students: • acknowledge the limits of their ability to cope with pressure during the work on the topics of the module
Module contents	• Core-concepts of the transportation domain • Modes of transportation (focus on the automotive sector) • Automated and connected driving (short introduction/overview) • Human factors in the automotive sector • Traffic infrastructure (focus on intersections) • Basic principles in traffic management
Recommended reading	• Maurer, M., Gerdes, J.C., Lenz, B., Winner, H. (Eds.) (2015). Autonomes Fahren (Technische, rechtliche und gesellschaftliche Aspekte), Springer (Open Access).

	- Braess, H.-H., Seiffert, U. (Eds.) (2012). Handbuch Kraftfahrzeugtechnik, Vieweg. - Tille, T. (2016). Automobil-Sensorik: Ausgewählte Sensorprinzipien und deren automobile Anwendung. Springer. - Treiber, M., Kesting, A. (2010). Verkehrsdynamik und -simulation (Daten, Modelle und Anwendungen der Verkehrsflussdynamik), Springer.

Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Practical work and oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	28
Exercises		2	SuSe	28
Total module attendance time				56 h

inf338 - Design of Autonomous Systems

Module label	Design of Autonomous Systems
Module code	inf338
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Fränzle, Martin Georg (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	Professional competences The students • are enabled to analyze and build autonomous systems. **Methodological competences** The students • know examples of existing autonomous systems, understand the elements involved in their architectural design and the rationale behind decomposing the problem into obligations for the respective system components. • analyze existing architectures for autonomous systems with respect to their performance and safety. • learn how to decompose a problem of designing an autonomous system into an architecture • are able to derive design obligations for its components, and can structure a pertinent safety case. • understand the software and hardware components necessary for achieving system autonomy and are able to design or instantiate these. **Social competences** The students • acquire hands-on experience in designing components for autonomous systems in small teams and present the underlying theory, their particular design decisions, and their personal evaluation to fellow students. **Self-competences** The students • can judge adequacy of their methodological skills for designing particular autonomous solutions • are able to assess the safety impact of such a solution and are therefore able to develop a personal ethical stance towards its realization
Module contents	The module consists of a lecture and an exercise part
Recommended reading	
Links	
Language of instruction	English

Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	Second half of semester	Presentation

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf339 - Industrie 4.0 Digitalization in Industrial Manufacturing

Module label	Industrie 4.0 Digitalization in Industrial Manufacturing
Module code	inf339
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Computing Science (Master) > Technische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Klös, Verena (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	The module consists of a lecture part and a seminar part, in which special topics of the lecture are prepared and presented by the students on the basis of examples. This gives a clear insight into the different aspects and allows further discussion. The preparation and presenting a presentation with subsequent discussion on the respective topic area offers a deeper understanding. **Professional competence** The student: • Recognize fundamental relationships of the digitization in industrial manufacturing • Gain knowledge about key competences of the digitization in industrial manufacturing • Develop practical knowledge about special topics of the digitization in industrial manufacturing • Put concrete approaches for discussion **Methological competence** The student: • Capture needed information and analyze them • Prepare the recorded information according to target group • Form an understanding of the digitization in industrial manufacturing **Social competence** The student: • present and discuss their own work on a technical level **Self-competence** The student: • understand their own leel of knowledge • learn how to prepare and present a specific topic
Module contents	The module conveys basic knowledge about the digitization of industrial production (Industrie 4.0). In addition to an overview of economic and technical aspects and opportunities of digitizing production, the module focuses on technologies for data acquisition, communication and control in production plants. Networked machine tools, Pproduction planning and control, organization, Quality and IT systems for planning and operation, The Gentelligent workpiece, Intelligent tools, Transfer systems, Assembly 4.0, Cyber Security, Convertible modular automation systems, Production transformation strategy, Business models

Recommended reading	
	• Handbuch Industrie 4.0 – Geschäftsmodelle, Prozesse, Technik“, Gunther Reinhart, 2017 • Handbuch Industrie 4.0 Bd.1 – Produktion“,Birgit Vogel-Heuser, Thomas Bauernhansl, Miachel ten Hompel, 2017 • Handbuch Industrie 4.0 Bd.2 – Automatisierung“,Birgit Vogel-Heuser, Thomas Bauernhansl, Miachel ten Hompel, 2017 • Handbuch Industrie 4.0 Bd.3 – Logistik“,Birgit Vogel-Heuser, Thomas Bauernhansl, Miachel ten Hompel, 2017 • „Handbuch Industrie 4.0 Bd.4 – Allgemeine Grundlagen“,Birgit Vogel-Heuser, Thomas Bauernhansl, Miachel ten Hompel, 2017

Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	every winter term
Module capacity	unlimited
Teaching/Learning method	V+S

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture therm	Oral exam

Type of course	Lecture
SWS	4
Frequency	SuSe or WiSe
Workload attendance time	28 h

inf340 - Uncertainty Modeling for Control in Digitalised Energy Systems

Module label	Uncertainty Modeling for Control in Digitalised Energy Systems
Module code	inf340
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Technische Informatik • Master's programme Digitalised Energy Systems (Master) > Digitalised Energy System Design and Assessment • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Rauh, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Basic knowledge of the control of linear time-continuous and/or time-discrete systems and/or robust control
Skills to be acquired in this module	The students identify fundamentals of uncertainty modelling in control systems as well as problem-specific methods for the consideration of uncertainty during simulation andobserver synthesis. **Professional competences** The students: • identify fundamentals of uncertainty modeling in control systems • characterize problem-specific solution techniques for systems with stochastic and set-based uncertainty • are aware of software implementations in simulation, control, and state estimation. **Methological competences** The students: • students identify fundamentals of uncertainty modelling in control systems • characterise problem-specific solution techniques for systems with stochastic and set-based uncertainty • are aware of software implementations in simulation, control, and state estimation. **Social competences** The students: • analyse problems of control-oriented uncertainty modelling • analyse fundamental solution techniques on a theoretical basis as well as transfer and generalise them independently toward novel research-oriented application scenarios. **Self competences** The students: • critically reflect the achieved results of their project work • acknowledge limitations of various approaches for a control-oriented uncertainty modeling.
Module contents	1. Mathematical modeling of uncertainty in linear and nonlinear dynamic systems 2. Stochastic modeling approaches

  - Probability distributions
  - Bayesian state estimation for discrete-time systems (linear/nonlinear) and for continuous-time systems (linear)
  - Linear estimation techniques in an extended state-space (Carleman linearization for special system classes)
  - Monte-Carlo methods
3. Estimation of states, parameters and simulation of uncertain processes
  - Outlook: Markov models
  - Outlook: Bayesian networks
4. Set-based approaches
  - Set-based algorithms: Forward-backward contractor and bisection techniques
  - Interval methods for a verified solution of ordinary differential equations and for a stability proof of uncertain systems
  - Estimation of states and parameters as well as simulation of uncertain processes
5. Outlook: Synthesis of controllers and state observers under an explicit description of uncertainty

Recommended reading

- Jaulin, L., Kieffer, M., Didrit, O., Walter, E., Applied Interval Analysis, Springer- Verlag, 2001.
- Papoulis, A.: Probability, Random Variables, and Stochastic Processes, McGraw- Hill, 4th Ed., 2002.
- Rauh, A. Folien/ Skript zur Vorlesung „Uncertainty Modelling for Control in DES“.

Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	every winter term
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	Following the event period	Portfolio or written exam; contents of portfolio will be announced at the beginning of the lecture period

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	2
Exercises		2	WiSe	1
Total module attendance time				3 h

inf341 - Robust Control and State Estimation in Digitalised Energy Systems

Module label	Robust Control and State Estimation in Digitalised Energy Systems
Module code	inf341
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Technische Informatik • Master's programme Digitalised Energy Systems (Master) > Digitalised Energy System Automation, Control and Optimisation • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Rauh, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Basic knowledge of the control of linear continuous-time and/or discrete-time systems or of robust control
Skills to be acquired in this module	The students identify fundamentals of robust control and state estimation as well as problem-specific solution techniques and their corresponding software implementation. **Professional competences** The students • identify fundamentals of robust control and state estimation • characterize problem-specific solution techniques for different classes of uncertainty • are aware of reliable software implementations. **Methological competences** The students • analyze problems of robust control and state estimation for dynamic systems • analyze fundamental solution techniques on a theoretical basis • transfer as well as generalize those independently to new fields of applications. **Social competences** The students • develop solution ideas for real-life control problems within an accompanying project in small teams • explain the obtained results in short presentations. **Self competences** The students • critically reflect the achieved results of their project work • acknowledge limitations of various approaches for robust control and state estimation.

Module contents	1. Robustness of linear systems/ system analysis
	  ◦ Boundary crossing theorem of Frazer and Duncan
	  ◦ Mikhailov criterion
	  ◦ Kharitonov criterion
	  ◦ Frequency response approaches
	2. Selected control design techniques/ control synthesis

- Parameter-space approach of Ackermann and Kaesbauer
    - Eigenvalue and eigenvalue domain assignment
    - H-infinity control
    - Frequency response approaches (Sensitivity function approaches in the frequency domain)
3. Robust LMI-based control techniques
    - Lyapunov stability
    - Polytopic uncertainty modeling
    - Optimality of solutions
4. Duality between control and observer synthesis
    - Robust state estimation
    - Sliding mode observers
5. Interval methods: Solution of static and dynamic problems (Enclosing function values, Branch-and-bound techniques, Verification techniques for differential equations)
6. Fundamentals: Fault detection and fault-tolerant control

Recommended reading

- Ackermann, J. Robust Control, Springer-Verlag, 2002.
- Gu, D.-W.; Petkov, P.H.; Konstantinov, M.M., Robust Control Design with MATLAB, Springer-Verlag, 2013
- Ostertag, E. Mono- and Multivariable Control and Estimation, Springer-Verlag, 2011
- Rauh, A. Folien/ Skript zur Vorlesung „Robuste Regelung und Zustandsschätzung“.
- Weinmann, A. Uncertain Models and Robust Control, Springer-Verlag, 1991

Links		
Language of instruction	English	
Duration (semesters)	1 Semester	
Module frequency	every winter term	
Module capacity	unlimited	
Teaching/Learning method	V+Ü	
Examination	Prüfungszeiten	Type of examination
Final exam of module	Written exam: at the end of the lecture period Portfolio: during the semester	Portfolio or written exam; contents of portfolio will be announced at the beginning of the lecture period

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf350 - Special Topics in 'Safety-Critical Systems' I

Module label	Special Topics in 'Safety-Critical Systems' I
Module code	inf350
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik
Responsible persons	• Fränzle, Martin Georg (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively - evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	See assigned course description, e.g. „Sicherheitsanalysetechniken“, „Zielarchitekturen Eingebetteter Systeme für Automotive-Anwendungen“, „Modellbasierter Systementwurf“, ...
Recommended reading	As announced in course
Links	
Language of instruction	German

Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	event from V, Ü, S, P

Examination	Prüfungszeiten	Type of examination
Final exam of module		
		Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf351 - Special Topics in 'Safety-Critical Systems' II

Module label	Special Topics in 'Safety-Critical Systems' II
Module code	inf351
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik
Responsible persons	• Fränzle, Martin Georg (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • iIdentify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	See assigned course description, e.g. „Sicherheitsanalysetechniken“, „Modellbasierter Systementwurf“, ...
Recommended reading	As announced in course
Links	
Language of instruction	German
Duration (semesters)	1 Semester

Module frequency	semi-annually	
Module capacity	unlimited	
Teaching/Learning method	event from V, Ü, S, P	

Examination	Prüfungszeiten	Type of examination
Final exam of module		
		Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf352 - Current Topics in 'Safety-Critical Systems' I

Module label	Current Topics in 'Safety-Critical Systems' I
Module code	inf352
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik
Responsible persons	• Fränzle, Martin Georg (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements

Skills to be acquired in this module

This module aims to integrate current developments in the specialization area "Safety Critical Systems" into the course of study in the appropriate course forms.

Professional competences
The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences
The students:

- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

Social competences
The students:

- communicate with users and experts convincingly

Self-competences
The students:

- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

Module contents

See assigned course description

Recommended reading

As announced in course

Links

Language of instruction	German	
Duration (semesters)	1 Semester	
Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	V or S	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf353 - CurrentTopics in 'Safety-Critical Systems' II

Module label	CurrentTopics in 'Safety-Critical Systems' II
Module code	inf353
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik
Responsible persons	• Fränzle, Martin Georg (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course description
Recommended reading	As announced in course
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester

Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	V or S

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf354 - Special Topics in 'Hybrid Systems' I

Module label	Special Topics in 'Hybrid Systems' I
Module code	inf354
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik
Responsible persons	• Fränzle, Martin Georg (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	See assigned course description, e.g. „Modellbasierter Systementwurf“, „Konstruktionsprinzipien ausgewählter Klassen von Fahrzeugfunktionen“
Recommended reading	As announced in course
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester

Module frequency	semi-annually	
Module capacity	unlimited	
Teaching/Learning method	2 event from V, Ü, S, P	

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Exercises or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	28 h

inf355 - Special Topics in 'Hybrid Systems' II

Module label	Special Topics in 'Hybrid Systems' II
Module code	inf355
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik
Responsible persons	• Fränzle, Martin Georg (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	See assigned course description
Recommended reading	As announced in course
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester

Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	2 event from V, Ü, S, P

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Exercises or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf356 - CurrentTopics in 'Hybrid Systems' I

Module label	CurrentTopics in 'Hybrid Systems' I
Module code	inf356
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik
Responsible persons	• Fränzle, Martin Georg (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course description
Recommended reading	As announced in course
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester

Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	V or S	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf357 - Current Topics in 'Hybrid System' II

Module label	Current Topics in 'Hybrid System' II
Module code	inf357
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik
Responsible persons	• Fränzle, Martin Georg (authorised to take exams) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course description
Recommended reading	As announced in course
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester

Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	V or S	

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf358 - Special Topics in 'Hardware/Software Systems' I

Module label	Special Topics in 'Hardware/Software Systems' I
Module code	inf358
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik
Responsible persons	• Fränzle, Martin Georg (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	See assigned course description, e.g. „Spezifikation und Modellierung Eingebetteter Systeme“
Recommended reading	As announced in course
Links	
Language of instruction	German
Duration (semesters)	1 Semester

Module frequency	semi-annually	
Module capacity	unlimited	
Teaching/Learning method	2 events from V, Ü, S, P	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	The exam period will be announced during the course	Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf359 - Special Topics in 'Hardware/Software Systems' II

Module label	Special Topics in 'Hardware/Software Systems' II
Module code	inf359
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik
Responsible persons	• Fränzle, Martin Georg (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	See assigned course description, e.g. „Spezifikation und Modellierung Eingebetteter Systeme“
Recommended reading	As announced in course
Links	
Language of instruction	German
Duration (semesters)	1 Semester

Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	2 events from V, Ü, S, P

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	The exam period will be announced during the course	Exrecises or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf360 - CurrentTopics in 'Hardware/Software Systems' I

Module label	CurrentTopics in 'Hardware/Software Systems' I
Module code	inf360
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik
Responsible persons	• Fränzle, Martin Georg (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course description, e.g. Energieeffizienz in der IKT, Smart Resource Integration, ...
Recommended reading	As announced in course
Links	
Language of instruction	German

Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	V or S

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf361 - Current Topics in 'Hardware/Software Systems' II

Module label	Current Topics in 'Hardware/Software Systems' II
Module code	inf361
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik
Responsible persons	• Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements

Skills to be acquired in this module

This module integrates current developments in the field in adequate study courses.
Professional competences
The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences
The students:

- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- echedule time processes and resources

Social competences
The students:

- communicate with users and experts convincingly

Self-competences
The students:

- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

Module contents

See assigned course description, e.g. „Energieeffizienz in der IKT“, „Smart Resource Integration“, ...

Recommended reading

As announced in course

Links	
Language of instruction	German
Duration (semesters)	1 Semester

Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	V or S	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	As announced in the according course

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf366 - Special Topics in 'Microrobotics and Control Engineering' I

Module label	Special Topics in 'Microrobotics and Control Engineering' I
Module code	inf366
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik
Responsible persons	• Fatikow, Sergej (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Keine Teilnehmervoraussetzungen
Skills to be acquired in this module	This module addresses current developments in the field of microrobotics. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	
Recommended reading	will be announced in course
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	every semester
Module capacity	unlimited
Teaching/Learning method	2 evets from V, S, Ü, P

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	will be announced during the course	Written exam or portfolio or presentation or oral examination

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	28 h

inf367 - Special Topics in 'Microrobotics and Control Engineering' II

Module label	Special Topics in 'Microrobotics and Control Engineering' II
Module code	inf367
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik
Responsible persons	• Fatikow, Sergej (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	See assigned course description
Recommended reading	As announced in course
Links	
Language of instruction	German
Duration (semesters)	1 Semester

Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	2 events from V, S, Ü, P	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	The exam period will be announced during the course	Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	28 h

inf368 - Current Topics in 'Microrobotics and Control Engineering' I

Module label	Current Topics in 'Microrobotics and Control Engineering' I
Module code	inf368
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik
Responsible persons	• Fatikow, Sergej (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Keine Teilnehmervoraussetzungen
Skills to be acquired in this module	This module addresses current developments in the field of microrobotics. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course
Recommended reading	Will be announced in course
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester

Module frequency	every semester
Module capacity	unlimited
Teaching/Learning method	V or S

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Portfolio or presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf369 - Current Topics in 'Microrobotics and Control Engineering' II

Module label	Current Topics in 'Microrobotics and Control Engineering' II
Module code	inf369
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik
Responsible persons	• Fatikow, Sergej (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module addresses current developments in the field of microrobotics. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course
Recommended reading	Will be announced in the assigned course
Links	Siehe zugeordnete Lehrveranstaltung

Languages of instruction		German, English
Duration (semesters)		1 Semester
Module frequency		every semester
Module capacity		unlimited
Teaching/Learning method		V or S
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Portfolio or presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf374 - Special Topics in 'Automotive' I

Module label	Special Topics in 'Automotive' I
Module code	inf374
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik
Responsible persons	• Fränzle, Martin Georg (module responsibility) • Rauh, Andreas (module responsibility) • Hein, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	The required prerequisites are specified in the details of the assigned course.
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	See assigned course description, e.g. „Zielarchitekturen Eingebetteter Systeme für Automotive-Anwendungen“
Recommended reading	As announced in course
Links	

Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	irregularly
Module capacity	unlimited
Teaching/Learning method	2 events from V, S, Ü, P

Examination	Prüfungszeiten	Type of examination
Final exam of module		
		Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf375 - Special Topics in 'Automotive' II

Module label	Special Topics in 'Automotive' II
Module code	inf375
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik
Responsible persons	• Hein, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research **Social competences** The students: • Support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	See assigned course description
Recommended reading	As announced in course
Links	
Language of instruction	German
Duration (semesters)	1 Semester

Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	2 events from V, S, Ü, P

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	The exam period will be announced during the course	Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf376 - Current Topics in 'Automotive' I

Module label	Current Topics in 'Automotive' I
Module code	inf376
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik
Responsible persons	• Hein, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course description
Recommended reading	As announced in course
Links	
Language of instruction	German
Duration (semesters)	1 Semester

Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	V or S	
Previous knowledge	none	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf377 - Current Topics in 'Automotive' II

Module label	Current Topics in 'Automotive' II
Module code	inf377
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik
Responsible persons	• Lehrenden, Die im Modul (authorised to take exams) • Hein, Andreas (module responsibility)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course description
Recommended reading	As announced in course
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester

Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	V or S	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf378 - Special Topics in Technical Computer Science I

Module label	Special Topics in Technical Computer Science I
Module code	inf378
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik
Responsible persons	• Fatikow, Sergej (module responsibility) • Fränzle, Martin Georg (module responsibility) • Peter, Andreas (module responsibility) • Rauh, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	
Skills to be acquired in this module	**Professional competences** The students • know recent technical or scientific developments in computer science • transfer computer science methods and procedure models to the requirements of IT application areas • evaluate the possibilities and limitations of computer science methods and tools and use them appropriately • use them appropriately **Methodological competences** The students • evaluate problems, formulate them with the help of formal models and examine them adequately • find and present (one or more) approaches to solving computer problems • select and evaluate tools and methods appropriate to the task investigate problems **Social competences** The students • cooperate in a team **Self-competences** The students • plan their independent approach to computer science
Module contents	The module aims to integrate current developments in computer engineering into the degree program in appropriate course forms.
Recommended reading	
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Reference text	If more than one course is assigned to the module, you should generally select courses with a total of 4 SWS, e.g. a lecture with an associated tutorial. Further information can be found in the description (details) of the assigned courses.
Teaching/Learning method	2 events from V, S, Ü, P

Examination	Prüfungszeiten	Type of examination
Final exam of module		
		Written exam or portfolio or presentation or oral exam The concretely chosen form of examination will be announced in the respective assigned courses.

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf379 - Special Topics in Technical Computer Science II

Module label	Special Topics in Technical Computer Science II
Module code	inf379
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik
Responsible persons	• Fränzle, Martin Georg (module responsibility) • Peter, Andreas (module responsibility) • Rauh, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	
Skills to be acquired in this module	**Professional competences** The students • know recent technical or scientific developments in computer science • transfer computer science methods and procedure models to the requirements of IT application areas • evaluate the possibilities and limitations of computer science methods and tools and use them appropriately • use them appropriately **Methodological competences** The students • evaluate problems, formulate them with the help of formal models and examine them adequately • find and present (one or more) approaches to solving computer problems • select and evaluate tools and methods appropriate to the task investigate problems **Social competences** The students • cooperate in a team **Self-competences** The students • plan their independent approach to computer science
Module contents	The module aims to integrate current developments in computer engineering into the degree program in appropriate course forms.
Recommended reading	
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Reference text	If more than one course is assigned to the module, you should generally select courses with a total of 4 SWS, e.g. a lecture with an associated tutorial. Further information can be found in the description (details) of the assigned courses.
Teaching/Learning method	events from V, S, Ü, P

Examination	Prüfungszeiten	Type of examination
Final exam of module		
		Written exam or portfolio or presentation or oral exam The concretely chosen form of examination will be announced in the respective assigned courses.

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

Theoretische Informatik

inf300 - Hybrid Systems

Module label	Hybrid Systems
Module code	inf300
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Technische Informatik • Master's Programme Computing Science (Master) > Theoretische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Fränzle, Martin Georg (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	
Skills to be acquired in this module	

The module gives an introduction to hybrid discrete-continuous systems, as arising by embedding digital hardware into physical environments, and it elaborates on state of the art methods for the mathematical modelling and the analysis of such systems. It thus provides central competences for understanding and designing reliable cyber-physical systems.

Professional competence
The students:

- characterise formal models of cyber-physical systems: hybrid automata, hybrid state transition systems
- name domain-specific system requirements: safety, stability, robustness
- name analysis methods: symbolic state-space exploration, abstraction and abstraction refinement, generalized Lyapunov-Methods
- use state-of-the-art analysis tools
- select and apply adequate modelling and analysis methods for concrete application scenarios
- apply methods to reduce large state spaces and reduce infinite-state systems by abstraction
- know the de-facto industry standards for system modelling and are able to apply the corresponding modelling framewortks and tools

Methodological competence
The students:

- mtdel heterogeneous dynamical systems with adequate modelling and design tools, in particular Simulink/Stateflow
- transfer modelling and analysis methods to other heterogeneous domains, e.g. socio-technical systems

Social competence
The students:

- work in teams
- solve complex modelling, design, and analysis tasks in teams

Self-competence
The students:

- reflect their actions and respect the scope of methods dedicated to hybrid systems

Module contents

Embedded computer systems continuously interact with their environment, which generally comprises state- and time-continuous components.The coupling of the embedded system to its environment thus induces complex interleavings between discrete computational and decision processes and continuous processes. The resulting processes are neither amenable to the analytic techniques of continuous control nor of discrete mathematics. They instead require a broader, integrated theory: hybrid discrete-continuous systems.The lectures provide an in-depth introduction into a variety of analysis and design methods of these computer-based systems and their recent extensions to cyber-physical systems The accompanying hands-on-project enhances the lecture by developing and using design and verification tools.

Recommended reading

- Luca P Carloni, Roberto Passerone, Allesandro Pinto & Alberto L Sangiovanni-Vincentelli: Languages and Tools for Hybrid System design.World Scientific, 2006.
- Wassim M. Haddad, VijaySekhar Chellaboina & Sergey G. Nersesov: Impulsive and Hybrid Dynamical Systems: Stability, Dissipativity, and Control. Princeton University Press, 2006
- Daniel Liberzon: Switching in Systems and Control. Birkhauser, 2003
- Michael Huth, Mark Ryan: Logic in Computer Science: Modelling and Reasoning About Systems. Cambridge University Press, 2004.
- Christel Baier, Joost-Pieter Katoen: Principles of Model Checking. MIT Press, 2008.

Links	
Languages of instruction	English , German
Duration (semesters)	1 Semester
Module frequency	every summer term
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Semester project including written work and final presentation

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		3	SuSe	42
Exercises		1	SuSe	14
Total module attendance time				56 h

inf455 - Model Checking

Module label	Model Checking
Module code	inf455
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Theoretische Informatik
Responsible persons	• Wehrheim, Heike (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Useful prerequisites: set theory, propositional and predicate logic, finite automata
Skills to be acquired in this module	Model checking is a technique for the automatic verification of hardware and software systems. In the course, the students develop knowledge and skills in requirements specification via temporal logic and the automatic algorithmic checking of systems with respect to requirements. **Professional competence** The students: • name the operators in temporal logics and the differences between linear-time and branching-time logics, - specify requirements in LTL and CTL • translate LTL formulae to Büchi automata • construct BDDs for boolean functions • describe CTL formulae in fixpoint form • apply model checking algorithms to Kripke structures • know the expressivity of bisimulation **Methodogical competence** The students: • apply formal modelling techniques • prove properties of temporal logics • use model checking tools for the verification of systems **Social competence** The students: • work on tasks in groups and discuss solutions • develop system descriptions in groups and interpret results of tools **Self-competence** The students: • organize their own work for the course
Module contents	• temporal logics LTL and CTL • Büchi automata • explicit model checking • Binary decision diagrams • Lattices, fixpoints, CTL as transformers • Symbolic model checking • bisimulation
Recommended reading	• Christel Baier, Joost-Pieter Katoen: Principles of Model Checking, MIT Press

- E. M. Clarke, Orna Grumberg, Doron Peled: Model Checking, MIT Press

Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	every summer term
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	at the end of the term	written or oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe or WiSe	28
Exercises		2	SuSe or WiSe	28
Total module attendance time				56 h

inf456 - Real-Time Systems

Module label	Real-Time Systems
Module code	inf456
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Theoretische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Olderog, Ernst-Rüdiger (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	
Skills to be acquired in this module	

Introduction to formal methods of the specification and verification of time sensitive systems and their combinations.

Professional competence

The students:

- learn about different models of time and real-time properties
- specify and verify real-time systems
- model real-time systems using Timed Automata and PLC-Automata
- apply the model checker UPPAAL for the verification of real-time properties
- specify real-time systems using the Duration Calculus
- learn about decidability and undecidability results for real-time systems

Methodological competence

The students:

- recognize logic and automata as adequate forms for describing real-time systems

Social competence

The students:

- work together in small groups to solve problems
- present their solutions to groups of other students

Self-competence

The students:

- learn persistence in pursuing difficult tasks
- learn precision in specifying problems

Module contents

Examples of time-critical systems are railway control systems, robots, or even gas burners. It is essential for these systems to comply with certain timing conditions. For example, the control of a railway crossing must close the gates not later than 4 seconds after the sensors have reported an approaching train. If the gates are open, they should stay that way for at least 15 seconds to allow for a safe crossing of vehicles. Different specification methods have been developed to describe such timing conditions. The Duration Calculus developed by Zhou Chaochen in 1991 is one attractive method. It is a logic combined with a calculus, in which the duration of states can be described. The course will introduce the Duration Calculus and will explain its application by means of examples. As further specification method Timed Automata introduced by Alur & Dill in 1994 will be presented. After the specification of real-time system requirements the verification of programs implementing these requirements will follow. The specification methods of the Duration Calculus and Timed Automata are used to describe the real-time behaviour of these programs. The correctness is then proven on the basis of these behavioral descriptions.

Topics:

- discrete and continuous model of time
- logics and automata models for the specification of real-time systems

(predicate logic, Duration Calculus, Timed CTL, Timed Automata, PLC-Automata)
- decidability and undecidability results for real-time systems
- model checker UPPAAL for Timed Automata
- formal specification of real-time systems using Duration Calculus as well as Timed Automata and PLC-Automata
- verification of concrete Timed Automata using the model checker UPPAAL,
- transformation of Duration Calculus for discrete time into regular languages
- implementability of real-time systems on PLC-like hardware

Recommended reading

Essential:

- E.-R. Olderog, H. Dierks: Real-Time Systems: Formal Specification and Automatic Verification, Cambridge University Press, 2008

Recommended:

- C. Heitmeyer and D. Madrioli, editors. Formal Methods for Real-Time Computing, Wiley, 1996.
- M. Joseph, editor. Real-time Systems -- Specification, Verification and Analysis, Prentice Hall, 1996 (siehe http://docencia.etsit.urjc.es/moodle/file.php/31/documentos/RTSbook.pdf).

Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module	At the end of the lecture period	Exercises and written or oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		3	SuSe or WiSe	42
Exercises		1	SuSe or WiSe	14
Total module attendance time				56 h

inf462 - Cryptography

Module label	Cryptography
Module code	inf462
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Praktische Informatik) • Master's Programme Computing Science (Master) > Theoretische Informatik
Responsible persons	• Peter, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Fundamental knowledge on algorithms, discrete structures, and linear algebra as for instance covered in the following bachelor courses at the UOL: • inf030 Programmierung, Datenstrukturen und Algorithmen • mat950 Diskrete Strukturen • mat955 Linear Algebra für Informatik
Skills to be acquired in this module	Students understand the foundations of modern cryptography. The students can explain the formal security definitions of the most essential cryptographic primitives and can apply proof techniques to show that a given cryptographic construction meets a given security definition. They can identify underlying cryptographic assumptions, analyze them and discuss them in context. In addition, the students are able to build cryptographic primitives that provably meet specific security goals. **Professional competences** The students • understand definitions of security for different cryptographic primitives, • discuss the importance of cryptography, • formalize cryptographic assumptions, and • carry out security proofs of cryptographic primitives. **Metological competence** The students • use cryptographic concepts and techniques to increase security, in particular regarding which protection goals can be achieved with which cryptographic techniques, • apply cryptographic mechanisms in simple scenarios, and • question the properties and limits of cryptographic concepts and combine different concepts in a meaningful way. **Social competence** The students • solve problems partially in small groups and thus improve their willingness to cooperate and their communication skills, • present solutions to cryptographic problems in front of the exercise group, • discuss their different solutions within the exercise group, and • improve their English language skills. **Self-competence** The students • motivate themselves to work on questions and problems in the domain of cryptography, • justify their own actions with theoretical and methodical knowledge, and • critically reflect on proposed solutions in relation to social expectations and consequences, taking into account the methods taught.

Module contents

The course provides a rigorous treatment of the basic paradigms and principles of modern cryptography. It puts an emphasis on formal definitions of security, precise assumptions, and rigorous proofs of security in well-defined models.

Concretely, the course deals with the formal and rigorous treatment of the following concepts and primitives:

- Private-Key Encryption
  - Definition of secure encryption and the concept of provable securit
  - Pseudorandom number generators
  - Constructing secure encryption schemes based on pseudorandomness
  - Security under Chosen-Plaintext Attacks (CPA)
  - Pseudorandom functions and the construction of CPA-secure encryption
  - Pseudorandom permutations and block ciphers
  - Security against Chosen-Ciphertext Attacks (CCA)
- Message Authentication Codes (MACs) and hash functions
- Cryptographic assumptions
- Key management
- Public-key cryptography
  - Recap on RSA
  - Attacks on RSA and mitigations
  - The KEM/DEM paradigm
  - Homomorphic Encryption (particularly Paillier)
  - Secret Sharing and Threshold Encryption
- Advanced topics (varying per semester), e.g.:
  - Secure Multiparty Computation
  - Post-Quantum Cryptography
- Zero-Knowledge Proofs

While some of the above topics are typically covered on a very high level in an introductory course on IT security, it should be stressed that this course on cryptography differs substantially by a much more in-depth treatment of the topics with a focus on formal definitions, precise assumptions, and rigorous proofs.

Recommended reading

- J. Katz and Y. Lindell. Introduction to Modern Cryptography. 3rd edition. Chapman & Hall, ISBN 978-0-815-35436-9, 2020
- D. Boneh and V. Shoup. A Graduate Course in Applied Cryptography. Version 0.6, 2023. Available at: http://toc.cryptobook.us/

Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	Every summer semester
Module capacity	30
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
		Written or oral exam The concretely chosen form of examination will be announced in the first week of the course.

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	0
Exercises		2	SuSe	0
Total module attendance time				0 h

inf481 - Software Analysis

Module label	Software Analysis
Module code	inf481
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Theoretische Informatik
Responsible persons	• Wehrheim, Heike (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	
Skills to be acquired in this module	Software analyses extract facts about programs from source code. Such facts can be employed by compilers to optimize programs during compilation, but can also be used to verify correctness of programs. The students get to know different analysis methods, specify such techniques themselves and implement them. **Professional competences** The students: • get to know data flow analysis and specify them • name the components of data flow systems • know when to apply widening operators in an analysis • are able to develop abstract domains and operators for abstract interpretation • know predicate abstraction and the principle of counterexample-guided abstraction refinement • know when and how to apply SSA forms • are able to judge the precision and scalability of points-to analyses **Methodological competences** The students: • are able to formally define analyses • are able to prove properties of analyses • are able to implement analysis **Social competences** The students: • work on tasks in groups and discuss solutions • implement analyses in groups. **Self-competences** The students: • organize their own work for the course
Module contents	• Data flow analyses • Abstract interpretation • Predicate abstraction, CEGAR • SSA forms • Slicing • Points-to analysis • Symbolic execution
Recommended reading	• Nielson, Nielson, Hankin: Principles of Program Analysis, Springer, 2004.
Links	
Language of instruction	German
Duration (semesters)	1 Semester

Module frequency	every second summer term
Module capacity	unlimited
Teaching/Learning method	V+Ü
Previous knowledge	Useful prerequisites: set theory, propositional and predicate logic, programming in an imperative language

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	at the end of the term	Written or oral Exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	28
Exercises		2	SuSe	28
Total module attendance time				56 h

inf484 - Special Topics in 'Correct Systems Design' I

Module label	Special Topics in 'Correct Systems Design' I
Module code	inf484
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Theoretische Informatik
Responsible persons	• Olderog, Ernst-Rüdiger (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	See assigned course description
Recommended reading	As announced in course
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester

Module frequency	semi-annual
Module capacity	unlimited
Teaching/Learning method	2 events from V, Ü, S, P

Examination	Prüfungszeiten	Type of examination
Final exam of module		
		Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf485 - Special Topics in 'Correct Systems Design' II

Module label	Special Topics in 'Correct Systems Design' II
Module code	inf485
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Theoretische Informatik
Responsible persons	• Olderog, Ernst-Rüdiger (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	keine
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	See assigned course description
Recommended reading	As announced in course
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester

Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	2 events from V, Ü, S, P	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf486 - Current Topics in 'Correct Systems Design' I

Module label	Current Topics in 'Correct Systems Design' I
Module code	inf486
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Theoretische Informatik
Responsible persons	• Olderog, Ernst-Rüdiger (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course description
Recommended reading	As announced in course
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester

Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	V or S

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf487 - Current Topics in 'Correct Systems Design' II

Module label	Current Topics in 'Correct Systems Design' II
Module code	inf487
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Theoretische Informatik
Responsible persons	• Olderog, Ernst-Rüdiger (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course description
Recommended reading	As announced in course
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester

Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	V or S	

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf489 - Special Topics in 'Formal Methods'

Module label	Special Topics in 'Formal Methods'
Module code	inf489
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Theoretische Informatik
Responsible persons	• Wehrheim, Heike (module responsibility) • Lehrenden, Die im Modul (Module counselling)
Prerequisites	
Skills to be acquired in this module	This module integrates current computer science developments into the informatics program, especially considering the selected focus area, by appropriate study courses **Professional competences** The students: • know recent technological or scientific computer science developments • transfer computer science methods and development models to IT application area requirements • evaluate the possibilities and limitations of computer science methods and tools and • apply them appropriately **Methodological competences** The students: • review problems, formulate them with formal models and explore them appropriately • identify and present (one or more) computer science problem solutions • select and evaluate appropriate tools and methods • examine problems with technical and scientific literature **Social competences** The students: • cooperate in a team **Self-competences** The students: • plan their informatical actions independently
Module contents	According to the assigned task
Recommended reading	will be announced in the course
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	2 events from V, Ü, S, P
Previous knowledge	Helpful prerequisites: functions, relations etc., logic and automata theory

Examination	Prüfungszeiten	Type of examination
Final exam of module		

Examination	Prüfungszeiten	Type of examination
	At the end of the lecture period in consultation with the lecturer	Portfolio or presentation or oral exam or written exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf490 - Current Topics in 'Formal Methods' I

Module label	Current Topics in 'Formal Methods' I
Module code	inf490
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Theoretische Informatik
Responsible persons	• Wehrheim, Heike (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current computer science developments into the informatics program, especially considering the selected focus area, by appropriate study courses **Professional competence** The students: • know recent technological or scientific computer science developments • transfer computer science methods and development models to IT application area requirements • evaluate the possibilities and limitations of computer science methods and tools and • apply them appropriately. **Methological competence** The students: • review problems, formulate them with formal models and explore them appropriately • identify and present (one or more) computer science problem solutions • select and evaluate appropriate tools and methods • examine problems with technical and scientific literature **Social competence** The students: • cooperate in a team **Self competence** The students: • plan their informatical actions idependently
Module contents	According to the assigned task
Recommended reading	will be announced in the course
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	V or S

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Portfolio or Presentation or oral exam or written exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf491 - Current Topics in Theoretical Computer Science

Module label	Current Topics in Theoretical Computer Science
Module code	inf491
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Theoretische Informatik
Responsible persons	• Wehrheim, Heike (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field of Theoretical Computer Science into adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course description
Recommended reading	As announced in course
Links	
Language of instruction	English
Duration (semesters)	1 Semester

Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	V or S

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf492 - Special Topics in Theoretical Computer Science I

Module label	Special Topics in Theoretical Computer Science I
Module code	inf492
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Theoretische Informatik
Responsible persons	• Wehrheim, Heike (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	
Skills to be acquired in this module	

The module aims to integrate current developments in the specialization area "Modeling and Analysis of Complex Systems" I into the course of study in the appropriate course forms.

Professional competencies
The students

- differentiate and contrast a subarea of computer science in which they have specialized in more detail or reflect on computer science in general
- recognize and evaluate the techniques and methods to be applied in their special field and their limitations
- identify, structure and solve problems also in new or emerging areas of their discipline
- apply state-of-the-art and innovative methods in investigating and solving problems, drawing on other disciplines as appropriate
- recognize the limits of current knowledge and technology and contribute to the further scientific and technological development of computer science
- discuss current developments in computer science and assess their significance

Methodological competencies
The students

- evaluate tools, technologies and methods and apply them in a differentiated manner
- creatively develop new and original approaches and methods
- reflect on problems also in new or emerging areas of their discipline and apply computer science methods for investigation and solution

Social Competencies
The students

- integrate their skills into team processes

Self-competencies
The students

- critically follow further developments in computer science in general and in their field of specialization
- carry out innovative activities in their professional field successfully and independentl

Module contents	depending on the assigned course
Recommended reading	will be announced in the course
Links	

Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	events from V, S, Ü, P
Previous knowledge	The required prerequisites are specified in the details of the assigned course.

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	at the end of the lecture term	Written exam or portfolio or presentation or oral examination

Type of course	Course selection
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf493 - Special Topics in Theoretical Computer Science II

Module label	Special Topics in Theoretical Computer Science II
Module code	inf493
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Theoretische Informatik
Responsible persons	• Wehrheim, Heike (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	

Skills to be acquired in this module

The aim of the module is to integrate current developments in theoretical computer science into the degree program in appropriate course formats.

Professional skills

The students:

- differentiate and contrast a sub-area of computer science in which they have specialized in more detail or reflect on computer science in general
- recognize and assess the techniques and methods to be used in their special field and their limitations
- identify, structure and solve problems in new or emerging areas of their discipline
- apply state-of-the-art and innovative methods to investigate and solve problems, drawing on other disciplines where appropriate
- recognize the limits of today's knowledge and technology and contribute to the further scientific and technological development of computer science
- discuss current developments in computer science and assess their significance

Methodological skills

The students:

- evaluate tools, technologies and methods and apply them in a differentiated manner
- creatively develop new and original approaches and methods
- reflect on problems in new or emerging areas of their discipline and apply computer science methods to investigate and solve them

Social skills

The students:

- integrate their skills into team processes

Personal skills

The students:

- pursue the further developments in computer science in general and in their specialized field successfully and independently carry out innovative activities in their professional field

Module contents

Depending on the assigned course

Recommended reading

will be announced in the course

Links

Language of instruction		English
Duration (semesters)		1 Semester
Module frequency		irregular
Module capacity		unlimited
Teaching/Learning method		events from V, S, Ü, P
Previous knowledge		The required prerequisites are specified in the details of the assigned course.
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	at the end of the lecture period	Oral exam or portfolio or presentation or written exam

Type of course	Course selection
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf494 - Current Topics in 'Modeling and Analysis of Complex Systems' I

Module label	Current Topics in 'Modeling and Analysis of Complex Systems' I
Module code	inf494
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Theoretische Informatik
Responsible persons	• Wehrheim, Heike (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course description, e.g. „Security: Grundlagen“ oder „Security for Cyberphysical Systems“
Recommended reading	As announced in course
Links	
Languages of instruction	German, English

Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	V or S

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf495 - Current Topics in 'Modeling and Analysis of Complex Systems' II

Module label	Current Topics in 'Modeling and Analysis of Complex Systems' II
Module code	inf495
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Theoretische Informatik
Responsible persons	• Wehrheim, Heike (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research - schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course description, e.g. „Security: Grundlagen“ oder „Security for Cyberphysical Systems“
Recommended reading	As announced in course
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester

Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	V or S

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf496 - Current Topics in 'Formal Methods'

Module label	Current Topics in 'Formal Methods'
Module code	inf496
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Theoretische Informatik
Responsible persons	• Wehrheim, Heike (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current computer science developments in formal methods into the informatics program by appropriate study courses **Professional competences** The students • know recent technological or scientific computer science developments • transfer computer science methods and development models to IT application area requirements • evaluate the possibilities and limitations of computer science methods and tools and • apply them appropriately. **Methological competencex** The students • review problems, formulate them with formal models and explore them appropriately • identify and present (one or more) computer science problem solutions • select and evaluate appropriate tools and methods • examine problems with technical and scientific literature **Social competences** The students • cooperate in a team **Self competences** The students • plan their informatical actions idenpendently
Module contents	According to the assigned task
Recommended reading	will be announced in the course
Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	V or S

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture term	presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

Angewandte Informatik

inf131 - Advanced Topics in Human Computer Interaction

Module label	Advanced Topics in Human Computer Interaction
Module code	inf131
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Computing Science (Master) > Praktische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction
Responsible persons	• Boll-Westermann, Susanne (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Useful previus knowledge: Interactive Systems
Skills to be acquired in this module	This course aims to provide a sample of some of the most recent and significant advances in this exciting area. Topics may include: situational awareness, designing for attention, ambient/peripheral interaction, computer support cooperative work and social computing (CSCW), ubiquitous and context-aware computing, haptic and gestural interaction, audio interaction, gaze-based interaction, biometric interfaces, and embedded, physical and tangible computing, mobile and wearable interfaces. This course is explicitly not focused on the methods used in HCI practice (i.e., user-centered design cycle), but rather focuses on (recent) research. **Professional competences** The students: • demonstrate a systematic understanding of knowledge and critical awareness of a selection of the recent research advances in the area of HCI • valuate and critique recent developments in the field of HCI on scientific and technological grounds • develop ability to conceptualize, design, implement, and evaluate user-centered systems and techniques. • plan an implement exploratory projects directed at envisioning and prototyping novel interactive artifacts **Methodological competences** The students: • analyze, review and critique research papers • carry out original research from start to finish • summarize and present research findings • work in a team to produce and evaluate prototypes of novel interactive artifact **Social competences** The students: • work collaboratively in groups to analyze and review research papers • summarize and present research findings to rest of class • discuss how HCI concepts and methods can be applied in analysis, design, and evaluation of interactive technologies. • discuss social and ethical implications of interactive technologies **Self-competences** The students:

- are comfortable tackling original research questions
- show aptitude in conceptualizing and running both qualitative and quantitative HCI experiments
- acquire the ability to summarize, analyze, and critique published (peer-review) research papers

Module contents

HCI is a fast-growing field, where scientific research in this area crosses multiple disciplines. The body of theoretical and empirical knowledge that can inform the design of effective systems is rapidly developing, which underscores the importance of current research in the field.
This course aims to provide a sample of some of the most recent and significant advances in this exciting area. Topics may include: situational awareness, designing for attention, ambient/peripheral interaction, computer support cooperative work and social computing (CSCW), ubiquitous and context-aware computing, haptic and gestural interaction, audio interaction, gaze-based interaction, biometric interfaces, and embedded, physical and tangible computing, mobile and wearable interfaces.
The course will consist of lectures and lab sessions. Lab sessions will cover assignments (writing paper reviews, presentations, and peer assessment). In addition to assignments and a final exam, a small part of the course includes a mini group-based HCI project.

Recommended reading

- The Computer for the 21st Century, Mark Weiser, Scientific American, September 1991, pp. 94 - 104.
- Bush, V. (1945). As We May Think. Atlantic Monthly. Design of Everyday Things, Chapters 1 to 7

- Greenberg, S. and Buxton, B. (2008). Usability Evaluation Considered Harmful (Some of the Time). Proceedings of the ACM Conference on Human Factors in Computing Systems (CHI 2008), 111-120.
- Olsen, D.R. (2007). Evaluating User Interface Systems Research. Proceedings of the ACM Symposium on User Interface Software and Techno

Links

https://uol.de/en/media-informatics/teaching/courses

Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	every winter term
Module capacity	24
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Project and oral exam Missing the exam If you cannot attend the exam with valid reasons (medical reason, exam schedule conflicts), you need to inform us before the exam, and submit a scanned copy of the evidence (medical certificate, course registration, boarding passes) within 5 days after the exam. • If the reason for missing the exam is valid, you will do your first try of the exam for the parts that you missed on the same date as the second chance exam.

Examination	Prüfungszeiten	Type of examination
		• If the reason is not valid, you will not get any score from that exam. If your overall score passed the course, you will not have a chance to take the exam again. **Grading:** Your grade will be calculated as follows: Scored Items % Final 40 Assignments A01–03 20 Mini HCI research project 40

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf303 - Fuzzy Control and Artificial Neural Networks in Robotics and Automation

Module label	Fuzzy Control and Artificial Neural Networks in Robotics and Automation
Module code	inf303
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Computing Science (Master) > Technische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Fatikow, Sergej (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	
Skills to be acquired in this module	Experts in different branches try to approach their application-specific control and information processing problems by using fuzzy logic and artificial neural networks (ANN). The experiences gathered up to now prove robotics and automation technology to be predestined fields of application of both these approaches. The major topics of the course are control problems in robotics and automation technology, principles of fuzzy logic and ANN and their practical appplications, comparison of conventional and advanced control methods, combination of fuzzy logic and ANN in control systems. The course gives a comprehensive treatment of these advanced approaches for interested students. **Professional competence** The students: • recognise control problems in robotics and automation technology, • name principles of fuzzy logic and ANN and their practical appplications, • compare conventional and advanced control methods, - characterise the combination of fuzzy logic and ANN in control systems **Methodological competence** The students: • will acquire knowledge of the tools, methods and applications in fuzzy logic and ANN • deepen their knowledge for the practical use of the given methods • can use common software tools for design and application of fuzzy logic and ANN **Social competence** The students: • gain experience in interdisciplinary work • are integrated into the recent research work Objective of the module / skills: **Self-competence** The students: • are able to transfer the gained knowledge for later use in their theses or studies for AMiR • can Design (complex) fuzzy logic controller and ANN systems • reflect their (control) solutions by using methods learned in this course
Module contents	• Control problems in robotics and automation technology • Basic ideas of fuzzy logic and ANN • Principles of fuzzy logic • Fuzzy logic of rule-based systems • ANN models

- ANN learning rules
- Multilayer perceptron networks and backpropagation
- Associative networks
- Self-organizing feature maps
- PID design principles
- Design of fuzzy control systems
- Fuzzy logic application examples
- Design of ANN control systems
- ANN application examples
- Fuzzy + Neuro: principles and applications

Recommended reading	Lecture notes will be provided, to prepare for oral examination
Links	
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period until the beginning of the next semester	Hands-on-exercises and oral Exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		3	SuSe	42
Exercises		1	SuSe	14
Total module attendance time				56 h

inf339 - Industrie 4.0 Digitalization in Industrial Manufacturing

Module label	Industrie 4.0 Digitalization in Industrial Manufacturing
Module code	inf339
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Computing Science (Master) > Technische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Klös, Verena (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	The module consists of a lecture part and a seminar part, in which special topics of the lecture are prepared and presented by the students on the basis of examples. This gives a clear insight into the different aspects and allows further discussion. The preparation and presenting a presentation with subsequent discussion on the respective topic area offers a deeper understanding. **Professional competence** The student: • Recognize fundamental relationships of the digitization in industrial manufacturing • Gain knowledge about key competences of the digitization in industrial manufacturing • Develop practical knowledge about special topics of the digitization in industrial manufacturing • Put concrete approaches for discussion **Methological competence** The student: • Capture needed information and analyze them • Prepare the recorded information according to target group • Form an understanding of the digitization in industrial manufacturing **Social competence** The student: • present and discuss their own work on a technical level **Self-competence** The student: • understand their own leel of knowledge • learn how to prepare and present a specific topic
Module contents	The module conveys basic knowledge about the digitization of industrial production (Industrie 4.0). In addition to an overview of economic and technical aspects and opportunities of digitizing production, the module focuses on technologies for data acquisition, communication and control in production plants. Networked machine tools, Pproduction planning and control, organization, Quality and IT systems for planning and operation, The Gentelligent workpiece, Intelligent tools, Transfer systems, Assembly 4.0, Cyber Security, Convertible modular automation systems, Production transformation strategy, Business models

Recommended reading	
	• Handbuch Industrie 4.0 – Geschäftsmodelle, Prozesse, Technik“, Gunther Reinhart, 2017 • Handbuch Industrie 4.0 Bd.1 – Produktion“,Birgit Vogel-Heuser, Thomas Bauernhansl, Miachel ten Hompel, 2017 • Handbuch Industrie 4.0 Bd.2 – Automatisierung“,Birgit Vogel-Heuser, Thomas Bauernhansl, Miachel ten Hompel, 2017 • Handbuch Industrie 4.0 Bd.3 – Logistik“,Birgit Vogel-Heuser, Thomas Bauernhansl, Miachel ten Hompel, 2017 • „Handbuch Industrie 4.0 Bd.4 – Allgemeine Grundlagen“,Birgit Vogel-Heuser, Thomas Bauernhansl, Miachel ten Hompel, 2017

Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	every winter term
Module capacity	unlimited
Teaching/Learning method	V+S

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture therm	Oral exam

Type of course	Lecture
SWS	4
Frequency	SuSe or WiSe
Workload attendance time	28 h

inf502 - Simulation

Module label	Simulation
Module code	inf502
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Hahn, Axel (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Programming knowledge, primarily in Java, is mandatory

Skills to be acquired in this module

Simulation is a major tool for gaining knowledge about systems and their behavior. It can be used to gain system understanding and prediction future system status. The module covers mathematical basic as well a basic simulation technology. The module completes itself by addressing application examples. By seminar and practical work, the students get hands on experience of simulation technologies.

Professional competence
The students:

- get an overview on methods, tools and application areas of simulation. They know what simulation can do and what are its limitation. Covered application are mainly in transportation and production domain.

Methodological competence
The students:

- know simulation technologies and model building basics
- understand the handling of time and problems of discretization.
- can solve problems with simulation after lecture. This includes modelling, use of simulation environment and evaluation of results.
- will be learned cause of practical use, the independent handling of research questions and the use of simulation as research method

Social competence
The students:

- gain team and social skills by self-organized development of simulation.

Self-competence
The students:

- can apply simulation technologies on scientific research questions.

Module contents

In lectures the students get background information and simulation basics. Then they apply their knowledge by developing an own simulation by using state of the art simulation environments

Recommended reading

- Bungart, H. J., Zimmer, S., Bucholz, M., & Pflüger, D. (2013). Modellbildung und Simulation.
- Bartholomae, F., & Wiens, M. (2016). Spieltheorie: ein anwendungsorientiertes Lehrbuch. Springer-Verlag.
- Banks, J., CARSON II, J. S., & Barry, L. (2010). Discrete-event system simulation fifth edition. Pearson.
- Wooldridge, M. (2009). An introduction to multiagent systems. John Wiley & Sons.on für wissenschaftliche Fragestellungen kritisch zu

hinterfragen

Links		
Languages of instruction		German, English
Duration (semesters)		1 Semester
Module frequency		annual
Module capacity		unlimited
Teaching/Learning method		V+S+P
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	Registration 2 weeks after the start of lectures	Portfolio consisting of a short presentation and project documentation

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Seminar		1	SuSe	14
Lecture		2	SuSe	28
Practical training		1	SuSe	14
Total module attendance time				56 h

inf510 - Energy Information Systems

Module label	Energy Information Systems
Module code	inf510
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master Applied Economics and Data Science (Master) > Specialization • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Environmental Modelling (Master) > Mastermodule
Responsible persons	• Lehnhoff, Sebastian (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements

Skills to be acquired in this module

The students will learn different approaches to integrate distributed facilities, the regulatory framework, relevant standards and architecture concepts of energy management systems and will be able to apply this knowledge.
Professional competence
The students:

- develop and evaluate IT-architectures for energy management systems
- model objects of this domain appropriately
- model energy information systems
- realise and differentiate advanced tasks of decentralised energy management systems

Methodological competence
The students:

- identify problems of energy management, analyse these problems systematically and provide solutions
- apply different simulation approaches of decentralised plants and consumers

Social competence
The students:

- discuss solutions for energy management systems in the group
- develop use cases in teams
- present self-developed solutions

Self-competence
The students:

- reflect their actions with regard to structuring and decomposing systems
- reflect their own use of power as a limited resource

Module contents

This module provides the computer science basics for energy management. It provides the requirements of energy supply information systems with the focus on technical components and the requirements of decentralised and renewable energy plants.
These are:

- Architectures for energy information systems, e.g. SOA, Seamless Integration Architecture (IEC TC 57), OPC-UA
- Norms and standards of energy industry data models (CIM, 61850)
- Systematisation of energy information system requirements based on ontologies
- Development, analysis and adaption of energy industry reference

models and processes
- Methods and technologies to support energy industry processes
- Methods and algorithms to support decision processes of the decentralised energy plants control
- Smart Grid plant communication, particularly for load management
- Methods for modelling and simulation of power supply system dynamics

Recommended reading	
	• Crastan V.: "Elektrische Energieversorgung II", Springer 2004 • Heuck K., Dettman K. D., Schulz D.: "Elektische Energieversorgung I", 7. Aufl., Vieweg 2007 • Konstantin, P.: "Praxisbuch Energiewirtschaft", Springer 2006 - Schwab, A.: "Elektroenergiesysteme, Springer 2009
Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+S

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the semester	Student research project or presentation

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Seminar		2	WiSe	28
Total module attendance time				56 h

inf511 - Smart Grid Management

Module label	Smart Grid Management
Module code	inf511
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Engineering Physics (Master) > Schwerpunkt: Renewable Energies • Master's Programme Environmental Modelling (Master) > Mastermodule • Sustainable Renewable Energy Technologies (Master) > Mastermodule
Responsible persons	• Lehnhoff, Sebastian (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	After successful completion of the course the students should be able to understand the existing structures and technical basis of energy systems to produce, transfer and distribute electricity and their interaction and dependency on each other. They should have developed an understanding for necessary IT- and process control technology components, methods and processes to control and operate electrical energy systems. The students are able to estimate and evaluate the requirements and challenges of ICT and computer science which are caused by the development and integration of unforeseable fluctuations of decentralised plants. The students will be able to estimate the influence of distributed control concepts and algorithms for decentralised plants and consumers in the so called Smart Grid energy systems. Regarding the requirements the students will be able to analyse the safety, reliability, realtime capability and flexibility of Smart Grid energy systems. **Professional competence** The students: • understand the existing structures and the technical basis of energy systems producing, transferring and distributing electricity and their interaction and dependency on each other. • develop an understanding for necessary IT- and process control technology components, methods and processes to control and operate electrical energy systems. • estimate and evaluate the requirements and challenges of ICT and computer science which are caused by the development and integration of unforeseeable fluctuations of decentralised plants. • estimate the influence of distributed control concepts and algorithms for decentralised plants and consumers in the so called Smart Grid energy systems. **Methodological competence** The students: • analyse the safety, reliability, realtime capability and flexibility of Smart Grid energy systems • use advanced mathemtical methods to calculate networks **Social competence** The students: • create solutions in small teams • discuss their solutions **Self-competence** The students: • reflect their own use of electricity as a limited resource

Module contents

Content of the Module: In this course information technology, economical energy industry and technical basic knowledge and methods are analysed by using concrete Smart Grid approaches. The basic calculation methods for an intelligent grid management are introduced. This module deals with the technical and economical framework for a permissable electrical network as well as mathematical modelling and calculation methods to analyse conditions of electrical energy networks (in stationary conditions).
These are:

- The organisation of the EU energy market (regulatory framework, responsibility in liberalisation of electrical energy systems)
- Establishment and operation of electrical energy supply networks (network topology, statutory duties of supply, supply quality/system services, malfunctions and protection systems)
- Network calculation (complex vector representation, effective/idle power, mathematical performance models/net model, transformation: node performance to node voltage and electricity, calculation of conductive current, current flow, fix-point-iteration, Newton-Raphson-Method, voltage drop, transformer model)
- Intelligent network management (Smart Grids), aggregation forms, machine learning approaches)

Recommended reading

Suggested reading:

- Crastan V.: "Elektrische Energieversorgung II", Springer 2004
- Heuck K., Dettman K. D., Schulz D.: "Elektische Energieversorgung I", 7. Aufl., Vieweg 2007
- Konstantin, P.: "Praxisbuch Energiewirtschaft", Springer 2006
- Schwab, A.: "Elektroenergiesysteme, Springer 2009

Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	jährlich
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the semester	written or oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		3	SuSe	42
Exercises		1	SuSe	14
Total module attendance time				56 h

inf513 - Energy Informatics Lab

Module label	Energy Informatics Lab
Module code	inf513
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Lehrenden, Die im Modul (authorised to take exams) • Lehnhoff, Sebastian (module responsibility)
Prerequisites	• Programming with Java • Programming with Python

Skills to be acquired in this module

Successfully completing this lecture will enable the students to mathematically model simple controllable electrical generators and consumers and to simulate them together with appropriate control algorithms within smart grid scenarios. To achieve this goal, students will start with deriving computational models from physical models and evaluate them. In order to manage the integration of control algorithms, students are taught the principles of cosimulation using the "mosaik" smart grid co-simulation framework as an example. Students will be able to understand and apply distributed, agent-based control schemes to decentralized energy generators and/ or consumers. As a result, students are able to analyze the requirements for successful application to real power balancing regarding capacity utilization, robustness, and flexibility. In addition, students learn the foundations of planning and conducting simulation based experiments as well as the interpretation of the results. Special attention will be paid on establishing a balance between the results' precision and robustness and the necessary effort (design of experiments) in order to gain as much insight into interdependencies with as few experiments as possible.

Professional competence

The students:

- derive and evaluate computational models from physical models
- use the "mosaik" smart grid co-simulation framework
- analyze the requirements for successful applications to real power balancing regarding capacity utilization, robustness, and flexibility
- name the foundations of planning and conducting simulation based experiments as well as the interpretation of the results
- are aware of the balance between the results' precision and robustness and the necessary effort (design of experiments) in order to gain as much insight into interdependencies with as few experiments.

Methodological competence

The students:

- model simple controllable electrical generators and consumers
- simulate simple controllable electrical generators and consumers with appropriate control algorithms within smart grid scenarios
- apply distributed agent-based control schemes to decentralized energy generators and/ or consumers
- evaluate simulation results
- search information and look into methods to implement models
- propose hyphothesis and check their validity with design of experiments methods

Social competence

The students:

- apply the pair progamming development technique
- discuss design decisions
- identify work packages and are responsible for it

Self-competence

The students:

- reflect on their own use of power as a limited resource

- accept and use criticism to develop their own behaviour

Module contents	In this practical course students: • model controllable, modulating electrical energy generators and consumers, • put their hands on mosaik (installation, description and configuration of scenarios, conduction of simulations), • learn the principles of agent-based heuristics for optimization problems in future smart grid scenarios, • learn about the challenges of implementing agent-based mechanisms (multi-criticality, convergency, quality) on the training, • learn the foundations for choice and design of simulation based experiments.
Recommended reading	Suggested reading: **Smart Grids:** • Konstantin, P.: "Praxisbuch Energiewirtschaft", Springer, 2006 • Schwab, A.: "Elektroenergiesysteme", Springer, 2009 **Multiagentensysteme:** • Sutton, R. S.; Barto, A. G.: "Reinforcement Learning", MIT Press, 1998 • Weiss, G.: "Multiagent Systems", MIT Press, 2013 • Ferber J.; Kirn, S.: "Multiagentensysteme: eine Einführung in die Verteilte Künstliche Intelligenz", Addison-Wesley, 2001 **Co-Simulation:** • Ptolemaeus, C.: "System Design, Modeling, and Simulation", UC Berkeley, 2013 • Law, A.: "Simulation Modeling and Analysis", McGraw-Hill, 2015 **Versuchsplanung:** • Kleppmann, W.: "Versuchsplanung", Hanser, 2013 • Klein, B.: "Versuchsplanung - DoE", Oldenbourg, 2011 • Goos, P.; Jones, B.: "Optimal Design of Experiments", Wiley, 2014 • Box, G. E. P.; Hunter, J. S.; Hunter, W. G.: "Statistics for Experimenters", Wiley, 2005 • Forrester, A.; Sobester, A.; Keane, A.: "Engineering Design via Surrogate Modelling", Wiley, 2008
Links	http://mosaik.offis.de
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Reference text	Elective module in the master specialization area (energy computer science). **Associated with the modules:** • Energieinformationssysteme • Smart Grid Management
Teaching/Learning method	P

Examination	Prüfungszeiten	Type of examination
Final exam of module		

Examination	Prüfungszeiten	Type of examination
	At the end of the semester	Oral exam

Type of course	Practical training
SWS	4
Frequency	SuSe
Workload attendance time	56 h

inf514 - Simulation-based Smart Grid Engineering and Assessment

Module label	Simulation-based Smart Grid Engineering and Assessment
Module code	inf514
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's programme Digitalised Energy Systems (Master) > Computer Science and Energy Informatics
Responsible persons	• Lehnhoff, Sebastian (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Basic programming in Java or Python
Skills to be acquired in this module	Goal of this module is to teach mathematical and methodological foundations of energy informatics and for conducting large-scale simulation studies **Professional competence** The students: • know methods to analyze black-box objective functions • recognize the relation between precision and reliability of expected results and the necessary surplus effort • know methods to determine cause-effect relations between input parameters with small numbers of simulations (experiments) • evaluate the significance of simulation results • characterize (distributed) algorithms by their properties • transfer proving techniques to distributed problems **Methological competence** The students: • choose suitable statistical methods to interpret simulation results • apply methods from design of experiments • apply significance tests to compare algorithms • generate arbitrarily distributed input data • present results from algorithm evaluation statistically sound **Social competence** The students: • discuss the own algorithm choice • present their results and discuss with other students **Self-competence** The students: • reflect their own usage of the scarce resource energy • reflect problems and uncertainties when using statistical methods • recognize the limits of simulation studies and their responsibility for choosing correct statistical methods • accept criticism and understand it as a suggestion for the further development of their own actions
Module contents	The goal of this module is to teach mathematical and methodological foundations of energy informatics and especially for conducting large-scale simulation studies.
Recommended reading	Will be announced in the lecture

Links		
Language of instruction	English	
Duration (semesters)	1 Semester	
Module frequency	every winter term	
Module capacity	unlimited	
Teaching/Learning method	V+Ü	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture term	Written exam or oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf515 - Intelligent Energy Systems

Module label	Intelligent Energy Systems
Module code	inf515
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Bremer, Jörg (module responsibility) • Lehnhoff, Sebastian (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Programming knowledge in Python

Skills to be acquired in this module

Das Modul befasst sich mit der Integration (verteilter) künstlicher Intelligenz in die zukünftige Steuerung des Energienetzes.
Das Modul vermittelt moderne Techniken der künstlichen Intelligenz und des maschinellen Lernens als Beitrag beispielsweise in der semi-automatischen Betriebsführung von Stromnetzen, bei der von Einsicht getriebenen Vermarktung von dezentralen Energieanlagen oder bei der Prognose von Last- und Erzeugungszeitreihen
Fachkompetenzen
Die Studierenden

- kennen Methoden zur Modellierung der Flexibilität von Energieanlagen mittels maschinellem Lernen
- können Flexibilitätsmodelle implementieren
- kennen verschiedene Ansätze der Agenten-basierten Modellierung und Koordination im elektrischen Netz
- kennen Techniken des Adversarial Resilience Learning
- bewerten verschiedene Verfahren des Deep und Reinforcement Learning hinsichtlich ihrer Eigenschaften und Eignung in der verteilten Lastplanung
- charakterisieren Methoden maschinellen Lernens anhand ihrer Eigenschaften

Methodenkompetenz

Die Studierenden

- erzeugen systematisch zulässige Lösungen mittels Einsatz von Dekodertechnik
- wenden maschinelles Lernen in verteilten Algorithmen praktisch an

Sozialkompetenz

Die Studierenden

- wenden die Entwicklungsmethode des Pairprogrammings an
- diskutieren die getroffenen Design Entscheidungen
- präsentieren ihre Arbeitsergebnisse anderen Studierenden

Selbstkompetenz

Die Studierenden

- reflektieren den eigenen Umgang mit der begrenzten Ressource Energie
- nehmen Kritik an und verstehen sie als Vorschlag für die Weiterentwicklung des eigenen Handelns
- erkennen die gesellschaftspolitische Verantwortung beim Einsatz von Methoden der künstlichen Intelligenz

Module contents

In dieser Veranstaltung werden

- mathematische Grundlagen Supportvektor-basierter Modellierungstechniken vermittelt
- geometrische Untervektorraummodellierungen vermittelt und von den Studierenden angewendet
- Grundlagen verteilter Algorithmen in Energienetzen vermittelt
- das Design intelligenter Agenten mittels Reinforcement Learning und Q-Learning vermittelt und praktisch angewendet
- Grundlagen des Adversarial Resilience Learning vermittelt

Recommended reading

- Lapan, Maxim. Deep Reinforcement Learning Hands-On: Apply modern RL methods, with deep Q-networks, value iteration, policy gradients, TRPO, AlphaGo Zero and more. Packt Publishing Ltd, 2018.
- Dokumentation von PandaPower unter https://pandapower.readthedocs.io/en/latest/
- Mehr wird in der Veranstaltung bekannt gegeben

Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	every summer term
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module	At the end of the course	oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		3	SuSe or WiSe	28
Exercises		1	SuSe or WiSe	28
Total module attendance time				56 h

inf516 - Distributed Operation in Digitalised Energy Systems

Module label	Distributed Operation in Digitalised Energy Systems
Module code	inf516
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's programme Digitalised Energy Systems (Master) > Digitalised Energy System Automation, Control and Optimisation
Responsible persons	• Nieße, Astrid (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Fundamentals of Optimization, Fundamentals of Digitized Energy Systems
Skills to be acquired in this module	After successful completion of this course, the students are able to analyze an application problem in cyber-physical energy systems to decide whether a distributed optimization approach could be usefully applied. Fundamentals of self-organizing systems are understood and can be transferred to specific applications. Furthermore, the basic concepts of distributed methods can be applied safely and transferred to an application case. **Professional competence** The students: • will be familiar with the basic concepts of distributed optimization and agent systems mentioned above **Methological competence** The students: • will be able to present the fundamental concepts of distributed optimization and agent systems mentioned above and apply them to applicationproblems in CPES **Social competence** The students: • create solutions in small teams • present and discuss their solutions • reflect the solutions of others in a constructive manner **Self competence** The students: critically questionthe application of learned methods to a real-world problem

Module contents	In this course, fundamentals of agent-based control with applications in cyber-physical power systems are reviewed, discussed, and reinforced in the accompanying programming exercise.
	
	These are:
	
	1. Multi-agent systems
	    ◦ Foundations and definitions
	    ◦ MAS architectures
	    ◦ Agent communication
	    ◦ cooperative and competetive agents MAS
	    ◦ learning in MAS
	2. Distributed Optimization
	    ◦ CASIMIR
	    ◦ Overview on distributed optimization
	    ◦ CSP and COP
	    ◦ Distributed SCP und COP

3. Self-organizing energy systems
4. Applications
   - Virtual Power Plants
   - QEMS and Microgrids
   - DSM and DR
   - Energy market applications
   - Swarms for storage management
   - Multi-purpose examples
5. Programming part
   - Agent framework mango
   - Co-simulation framework mosaik
   - Power grid simulation pandapower

Recommended reading

- Yoav Shoham und Kevin Leyton-Brown Multiagent Systems: Algorithmic, Game- Theoretic, and Logical Foundations New York: Cambridge University Press, 2008, ISBN: 9780521899437
- Michael Wooldridge An introduction to multiagent systems Wiley, 2009, ISBN: 0470519460 3.
- Russell und Peter Norvig Artificial intelligence : a modern approach Boston Pearson, 2018, ISBN: 0134610997;
- Nancy Ann Lynch Distributed algorithms Kaufmann, 2003, ISBN: 1558603484

Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	every winter term
Module capacity	50
Teaching/Learning method	V+Ü
Previous knowledge	Fundamentals of Optimization, Fundamentals of Digitized Energy Systems

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	In the current semester and at the end of the event	Portfolio or oral exam or written exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf524 - Medical Basics

Module label	Medical Basics
Module code	inf524
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Computing Science (Master) > Interdisziplinäre Module
Responsible persons	• Wulff, Antje (module responsibility) • Klausen, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No specific prior knowledge is required

Skills to be acquired in this module

The aim of the modul is to provide students with a basic knowledge of humand medicine. This should facilitate the understanding of the domain in case of a career choice or focus on medical informatics / medical technology and lead to basics for own questions and ideas for the application of methods of informatics in medicine.

Professional competence
The students

- learn the basics of medical terminology (Terminologia Anatomica) and the anatomy of the human body and can name the most important structure in technical language
- Know the basics of the physiology of the human body and can descriube the essential body functions
- Gain insights into pathophysiological processes of the human body and the associated effects on the function of the human organism
- Know the control circuits of the human body for maintaining important body unctions and know that this control circuits can be used as a possibility to intervene in processes of the human body
- Know reference values of important physiological paremeters and can derive conclusions on body functions

Methodological competence
The students

- know the possible measurement procedures resulting from the physiological processes of the human body.
- pply measurement procedures to describe and evaluate human body functions. They can name examples of use and examples of interpretation
- know influencing variables that affect the interpretation of results from measurement procedures as well as the limits of measurement procedures
- learn how to carry out examinations according to protocols and how to document the results in a standardized way.

Social competence
The students

- experience an appreciative interaction with each other through regular role changes
- they take on the role of the test person as well as that of the experimenter
- an appreciative way of dealing with each other.
- describe in detail the data obtained in measurement procedures and consider them critically with other students
- integrate professional and factual criticism into their own courses of action
- use simulated examples from everyday clinical practice to learn the standardized procedures necessary to ensure patient safety

Self competence
The students

- deal with the function, the efficiency of the own body but also with its limits
  deal with the life cycle of conception, birth, adolescence, adulthood and aging

Module contents	See assigned course description
Recommended reading	As announced in course
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	every summer term
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module	At the end of the lecture period	Written exam or oral exam The chosen form of examination will be announced in the first week of the course

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	28
Exercises		2	SuSe	28
Total module attendance time				56 h

inf525 - Medical Informatics I

Module label	Medical Informatics I
Module code	inf525
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Wulff, Antje (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No specific prior knowledge is required

Skills to be acquired in this module

Introduction to medical informatics

Professional competences

The students

- know the application areas of medical informatics
- know the challenges of informatics in the field of health care
- know IT solutions and infrastructures in the field of health care
- know standards for data exchange and data-driven communication in health care

Methological competences

The students

- recognize and be able to apply the basic methods in the field of medical informatics, specifically
- learn how to analyze and model health care processes, information systems, and data
- understand medical information models and communication standards

Social competences

The students

- recognize the importance of interdisciplinary communication and collaboration in digitalisation in medicine
- develop, present and discuss the solutions from the exercises with others

Self competences

The students

- are aware of their heterogeneous tasks, responsibility and influence as a computer scientist in the health care sector
- reflect on problems and solutions, incorporating the methods they have learned

Module contents

The assigned lectures will provide an overview of the fields of medical informatics and the unique challenges of applying informatics methods and technologies to medicine and health care.

Recommended reading		
Links		
Languages of instruction	German, English	
Duration (semesters)	1 Semester	
Module frequency	annually in the winter term	
Module capacity	unlimited	
Teaching/Learning method	V+Ü	

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	at the end of the lecture period	written or oral exam The chosen form of examination will be announced in the first week of the course

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf526 - Medical Informatics II

Module label	Medical Informatics II
Module code	inf526
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Wulff, Antje (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Basic programming skills
Skills to be acquired in this module	In-depth understanding about medical informatics. **Professional competences** The students • know the application areas of medical informatics • know the challenges of informatics in the field of health care • know IT solutions and infrastructures in the field of health care • know standards for data exchange and data-driven communication in health care and from the field of medical terminologies **Methological competences** The students • learn the in-depth application of more advanced, specialized methods in the field of medical informatics, specifically including • Modeling and integration of medical information and data using current interoperability and communication standards. • Analysis and simulation of processes and data-based communication paths as well as handling of healthcare information systems **Social competences** The students • recognize the importance of interdisciplinary communication and collaboration in digitalisation in medicine • develop, present and discuss the solutions from the exercises with others **Self competences** The students • are aware of their heterogeneous tasks, responsibility and influence as a computer scientist in the health care sector • reflect on problems and solutions, incorporating the methods they have learned
Module contents	In the assigned lectures, individual partial aspects from the subject area of medical informatics and the special challenges of the application of informatic methods and technologies in medicine and health care are to be deepened. In the lectures, topics from "Medical Informatics I" or "Introduction to Medical Informatics" (Bachelor) will be deepened.
Recommended reading	Tim Benson, Grahame Grieve – Principles of Health Interoperability. SNOMED

	CT, HL7 and FHIR, 3. Auflage Springer, 978-3319303680 Further will be announced in the lecture

Links		
Languages of instruction	German, English	
Duration (semesters)	1 Semester	
Module frequency	every summer term	
Module capacity	unlimited	
Teaching/Learning method	V+Ü	

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	at the end of the lecture period	Portfolio, written exam, practical exercise or oral exam The chosen form of examination will be announced in the first week of the course

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	28
Exercises		2	SuSe	28
Total module attendance time				56 h

inf527 - Big Data Analytics and Clinical Decision Support

Module label	Big Data Analytics and Clinical Decision Support
Module code	inf527
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Wulff, Antje (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No specific prior knowledge is required

Skills to be acquired in this module

In-depth understanding about the processing of medical data sets in the context of Data Analytics, Big Data in medicine and the development and importance of (decision) support tools.

Professional competences

The students

- know the sources, characteristics and diversity of medical data and the significance of Big Data in medicine
- know methods for designing (decision) support applications, including the processing of relevant data and information, with regard to a medical issue
- know application classes and types of (decision) support applications and tools
- know professional, organizational and regulatory requirements and framework conditions for data analysis and application development in the healthcare sector

Methological competences
The students

- can familiarize themselves with a medical, data-driven problem and solve it using familiar methods from the various areas of requirements elicitation, knowledge management, conception, implementation and evaluation
- can process given data in a targeted manner with regard to a medical-informational problem and discuss results critically
- can present and hand over results, e.g. decision support applications (especially for medical experts), in a way that adds value.

Social competences
The students

- learn the interdisciplinary exchange in this context and understand its importance and necessity
- develop, present and discuss the solutions from the exercises with others

Self competences
The students

- can assess their role and importance in the analysis of medical data and the development of medical support applications/tools
- recognize the limits of their (specialist) perspective and the added value of the domain knowledge of others
- critically reflect on problems and solutions, incorporating the methods they have learned

Module contents

Against the background of "Big Data in Medicine" and the increasing

	digitalization of medicine in general, the assigned lectures aim to impart knowledge on the characteristics, analysis and handling of medical data for the development, application and evaluation of (decision) support applications/tools in healthcare.
Recommended reading	Papademetris X, Quraishi AN, Licholai GP. Introduction to Medical Software. Foundations for Digital Health, Devices and Diagnostics, 978-1316514993 Further will be announced in the course
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	every winter term
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	at the end of the lecture period	Portfolio

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercise or project		2	WiSe	28
Total module attendance time				56 h

inf535 - Computational Intelligence I

Module label	Computational Intelligence I
Module code	inf535
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master Applied Economics and Data Science (Master) > Data Science • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering • Master's Programme Environmental Modelling (Master) > Mastermodule
Responsible persons	• Kramer, Oliver (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Basics of statistics
Skills to be acquired in this module	After successful completion of the course, students should have acquired the ability to master the presented methods in theory and practice. The students should be able to recognize and model corresponding optimization and data analysis problems themselves and to apply the methods unerringly. **Professional competence** The students: • recognise optimisation problems • implement simple algorithms of heuristic optimisation • critically discuss solutions and selection of methods • deepen previous knowledge of analysis and linear algebra **Methodological competence** The students: • deepen programming skills • apply modelling skills • learn about the relation between problem class and method selection **Social competence** The students: • cooperatively implement content introduced in lecture • evaluate own solutions and compare them with those of their peers **Self-competence** The students: • evaluate own skills with reference to peers • realize personal limitations • adapt own problem solving approaches with reference to required method competences
Module contents	Computational Intelligence comprises intelligent and adaptive methods for optimisation and learning. The module "Computational Intelligence I" concentrates on methods for evolutionary optimisation and heuristic approaches. The exercises introduce and deepen practical aspects of the implementation and algorithmic design, also taking into account application aspects. **Overview of Content:**

- foundations of optimisation
- genetic algorithms and evolution strategies
- parameter control and self-adaptation
- runtime analysis
- swarm algorithms
- constrained optimisation
- multi-objective optimisation
- meta-modeling

Recommended reading

- EIBEN, A. E.; SMITH, J. E.: Introduction to Evolutionary Computing. Springer, 2003.
- KENNEDY, J.; EBERHART, R.C.; YUHUI, S.: Swarm Intelligence. Morgan Kaufmann, 2001.
- KRAMER, O.: Computational Intelligence. Springer, 2009.
- RUTKOWSKI, L.: Computational Intelligence
- Methods and Techniques. Springer, 2008.
- ROJAS, R.: Theorie der neuronalen Netze: Eine systematische Einführung. Springer, 1993.

Links	
Languages of instruction	English , German
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Written or oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf536 - Computational Intelligence II

Module label	Computational Intelligence II
Module code	inf536
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master Applied Economics and Data Science (Master) > Data Science • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering • Master's Programme Environmental Modelling (Master) > Mastermodule
Responsible persons	• Kramer, Oliver (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	useful previous knowledge: Linear Algebra, Stochastics
Skills to be acquired in this module	In the lecture "Convolutional Neural Networks" you will learn the basics of Convolutional Neural Networks, from methodological understanding to implementation. **Professional competence** The Students: • will learn Deep Learning expertise, which are essential qualifications as AI experts and Data Scientists. **Methodological competence** The Students: • learn the methods mentioned as well as the implementation in Python, NymPy and Keras. **Social competence** The Students: • are encouraged to discuss the taught content in groups and work together to implement the programming tasks in the exercises **Self-competence** The Students: • are guided to conduct independent research on advanced methods as the teaching field changes dynamically
Module contents	Students learn the basics of machine learning and in particular the topics of dense layers, cross-entropy, backpropagation, SGD, momentum, Adam, batch normalization, regularization, convolution, pooling, ResNet, DenseNet, and convolutional SOMs
Recommended reading	• Deep Learning by Aaron C. Courville, Ian Goodfellow und Yoshua

Bengio

Links		
Language of instruction	English	
Duration (semesters)	1 Semester	
Module frequency	every summer term	
Module capacity	unlimited	
Teaching/Learning method	V+Ü	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	lecture-free period at the end of the semester	written exam, e-exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	28
Exercises		2	SuSe	28
Total module attendance time				56 h

inf537 - Intelligent Systems

Module label	Intelligent Systems
Module code	inf537
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Sauer, Jürgen (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Production oriented business informatics
Skills to be acquired in this module	Professional competence The students: • name the structure of agent-based systems • use problem-solving methods for complex problems • characterise the application area of process planning • evaluate the suitablilty of processes regarding to specific problems **Methodological competence** The students: • assign problem-solving methods to different problems **Social competence** The students: • implement selected methods in small teams **Self-competence** The students: • develop own solutions for given problems
Module contents	A lot of application areas use "intelligent" problem-solving methods. These are the main focus of this lecture. They will be illustrated by examples in order to enhance the students' problem-solving abilities. **These inlcude:** • A brief introduction into AI • Agent systems and • Solution methods of AI like heuristics, meta-heuristics, soft computing methods. To apply and foster the contents of the lecture, an intelligent planning system is implemented in practical exercises.
Recommended reading	Suggested reading: • Sauer, J.: Intelligente Ablaufplanung in lokalen und verteilten Anwendungsszenarien, Teubner, 2004 • Russel/Norvig: Künstliche Intelligenz, 3rd edition, Pearson, 2012 • Ghallab/ Nau/Traverso: Automated Planning, Morgan Kaufman, 2004

Links		
Languages of instruction	German, English	
Duration (semesters)	1 Semester	
Module frequency	annual	
Module capacity	unlimited	
Teaching/Learning method	V+Ü	

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Practical exercises and oral exam or practical exercises and written exam or portfolio

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf538 - Management of IT-Services

Module label	Management of IT-Services
Module code	inf538
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Sauer, Jürgen (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements

Skills to be acquired in this module

Professional competence
The students:

- characterise problems that occur during the operation of large-scale operating systems
- characterise conceptional, technical, economical and organizational problem-solving processes
- use these concepts to solve problems validly

Methodological competence
The students:

- describe a current problem area based on information from the internet and literature

Social competence
The students:

- present their findings on a problem area
- discuss their results regarding a specific application area

Self-competence
The students:

- reflect actual concepts with regard to specific application areas

Module contents

Content of the Module:
"Adaptive Computing" deals with the field of concepts and solutions to manage large scale application systems or dynamic data centers. Technically oriented solutions like the configuration of data centers such as the hard- and software virtualization, the high availability, the storage management and the identity management are not the only contributions of Adaptive Computing. Others are organisational aspects of companies, such as personnel planning and service agreements. This module provides and compiles current topics of Adaptive Computing. The module also presents and evaluates several Adaptavie Computing technologies. Current HW-/ SW-concepts of large-scale application systems, strategies, service management and security concepts are specifically included. The lecture introduces current concepts and solutions for the management of dynamic data centers. Among others, the following subjects are provided:

- IT-Strategy, -Organisation
- ITIL (overview)
- Service-Management Tools (e.g. OTRS)
- Outsourcing
- Security (policies, privacy, data security, safety)
- Spatial design of data centers
- HW-Strategies: Cluster, Storage, ...

- Virtualization
- IdM
- Portals
- Configuration management
- Accounting, performance calculation and evaluation, perfomance indicators
- SOA, EAI
- Controlling tools, Monitoring
- Solutions: SAP Adaptive Computing

Recommended reading	Suggested reading: • current company data • current materials from internet • Böttcher, Roland: IT-Servicemanagement mit ITIL V3 : Einführung, Zusammenfassung und Übersicht der elementaren Empfehlungen, Heise, 2008. • Bullinger, Hans-Jörg, Service Engineering : Entwicklung und Gestaltung innovativer Dienstleistungen, Springer, 2006 • Tiemeyer, Ernst: Handbuch IT-Management: Konzepte, Methoden, Lösungen und Arbeitshilfen für die Praxis, Hanser, 2006
Links	
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	jährlich
Module capacity	unlimited
Teaching/Learning method	V+S+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	at the end of the semester	Portfolio

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture and seminar		2	SuSe	28
Exercises		2	SuSe	28
Total module attendance time				56 h

inf541 - Data Challenge

Module label	Data Challenge
Module code	inf541
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Lehrenden, Die im Modul (module responsibility) • Marx Gómez, Jorge (module responsibility) • Bremer-Rapp, Barbara (module responsibility) • Solsbach, Andreas (module responsibility)
Further responsible persons	Barbara Bremer-Rapp
Prerequisites	useful prior knowledge: Basics/knowledge of: • Python programming and/or R programming • Statistics
Skills to be acquired in this module	After successful completion of the course, students should be able to answer specific, entrepreneurial questions with the help of data-driven methods. The handling of data should be mastered unerringly in the programming languages Python and/or R. Furthermore, competences in the field of algorithmics and data storytelling should be developed. The module teaches basic skills in the field of data science and the application of various methods and algorithms. The cooperation with a practice partner ensures that the students work on a problem that is as real and practical as possible. By working independently on the problem and the final presentation of the results, further soft skills of the students will be trained. **Professional competence** The students: • learn how to handle structured and unstructured data sources. • acquire practical knowledge about different methods of data science. • learn basic procedures in the implementation of data science projects. • follow and refine the implementation of the practical learning by means of a partly given model scenario, but also by self-initiatives. **Methodological competence** The students: • are able to explore and analyze data sets • recognize connections in large data sets • form a hypothesis for the solution of a business problem. **Social competence** The students: • work in groups, identify work packages and take on responsibility for the jobs assigned to them. • discuss and introduce the results on a functional level. **Self-competence** The students: • reflect their approach on the basis of self-defined goals. • collect and analyze required information. • prepare the collected information in a target group-oriented manner
Module contents	

If methodological competence in the field of data science is to be learned and expanded, this is usually only possible with the help of open available, idealized data sets and exemplary tasks. Basic programming skills can be acquired in this way, but dealing with real business problems and solving them with the help of data science methods can only be learned through practice. In this module, a real problem of a practice
partner is presented, this partner provides data and domain knowledge and then a data-centered solution for this problem must be designed and implemented independently.
Within the module, the following topics are dealt with:

- Exploration and analysis of data
- Methods of data science (e.g. deep learning)
- Dealing with programming languages and development frameworks (R, Python, Tensorflow)
- Hypothesis Formation and Data Storytelling

Recommended reading

- Francois Chollet (2017): Deep Learning with Python, Manning.
- Thomas A. Runkler (2015): Data Mining: Modelle und Algorithmen intelligenter Datenanalyse. Springer Vieweg, Berlin.
- Wolfgang Ertel (2016): Grundkurs Künstliche Intelligenz: Eine praxisorientierte Einführung. Springer Vieweg, Berlin.
- Wes McKinney. (2018): Datenanalyse mit Python: Auswertung von Daten mit Pandas, NumPy und IPython. O'Reilly.

Links

https://uol.de/vlba

Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	30
Teaching/Learning method	Practical event

Examination	Prüfungszeiten	Type of examination
Final exam of module	During the semester break, after the end of the lecture period	Portfolio

Type of course	Practical training
SWS	4
Frequency	SuSe or WiSe
Workload attendance time	56 h

inf581 - Special Topics in 'Digitalised Energy Systems' II

Module label	Special Topics in 'Digitalised Energy Systems' II
Module code	inf581
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's programme Digitalised Energy Systems (Master) > Digitalised Energy System Automation, Control and Optimisation
Responsible persons	• Nieße, Astrid (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field of Digitalised Energy Systems in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or • evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The Students: • evaluate tools, technologies and methods • sophisticatedly combine new and original approaches and methods • creatively evaluate problems/tasks, including new or developing subject areas of their discipline • apply computer science methods for solutions and research **Social competences** The Students: • support team process by their abilities **Self-competences** The Students: • pursue the overall and special computer science development • critically implement innovative professional activities effectively and independently
Module contents	See assigned course description
Recommended reading	Will be announced in the course
Links	

Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Portfolio or presentation or oral examination

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	see frequency of module offering	28
Exercises		2	see frequency of module offering	28
Total module attendance time				56 h

inf584 - Special Topics in 'Energy Informatics' I

Module label	Special Topics in 'Energy Informatics' I
Module code	inf584
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's programme Digitalised Energy Systems (Master) > Digitalised Energy System Automation, Control and Optimisation
Responsible persons	• Lehnhoff, Sebastian (authorised to take exams) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods • sophisticatedly combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline • apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	See assigned course description
Recommended reading	As announced in course
Links	

Language of instruction	English	
Duration (semesters)	1 Semester	
Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	2 evets from V, S, Ü, P	
Examination	Prüfungszeiten	Type of examination
Final exam of module	At the end of the lecture period	Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf585 - Special Topics in 'Energy Informatics' II

Module label	Special Topics in 'Energy Informatics' II
Module code	inf585
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's programme Digitalised Energy Systems (Master) > Digitalised Energy System Automation, Control and Optimisation
Responsible persons	• Lehnhoff, Sebastian (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	See assigned course description
Recommended reading	As announced in course
Links	
Language of instruction	German

Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	2 events form V, S, Ü, P

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf586 - Current Topics in 'Energy Informatics' I

Module label	Current Topics in 'Energy Informatics' I
Module code	inf586
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's programme Digitalised Energy Systems (Master) > Innovation Topics and Smart Grids
Responsible persons	• Lehnhoff, Sebastian (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methological competences** The students • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time, processes and resources **Social competences** The students • communicate with users and experts convincingly **Self competences** The students • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course description
Recommended reading	Depending on the assigned course

Links		
Language of instruction		English
Duration (semesters)		1 Semester
Module frequency		irregular
Module capacity		unlimited
Teaching/Learning method		V or S
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	SuSe or WiSe
Workload attendance time	28 h

inf587 - Current Topics in 'Energy Informatics' II

Module label	Current Topics in 'Energy Informatics' II
Module code	inf587
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's programme Digitalised Energy Systems (Master) > Innovation Topics and Smart Grids
Responsible persons	• Lehnhoff, Sebastian (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methological competences** The students • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluateproblems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time, processes and resources **Social competences** The students • communicate with users and experts convincingly **Self competences** The students • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course description
Recommended reading	Will be announced in the course

Links		
Language of instruction	English	
Duration (semesters)	1 Semester	
Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	V or S	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Written exam or portfolio or presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	SuSe or WiSe
Workload attendance time	28 h

inf588 - Special Topics in 'Medical Informatics'' I

Module label	Special Topics in 'Medical Informatics'' I
Module code	inf588
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Hein, Andreas (module responsibility) • Wulff, Antje (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No specific prior knowledge is required
Skills to be acquired in this module	The module aims to integrate current developments in the specialization area "Medical Informatics" into the course of study in the appropriate course forms. **Professional competences** • The students: • differentiate and contrast a subfield of computer science in which they specialize in more detail or reflect on computer science in general • recognize and evaluate the techniques and methods to be used in their area of specialization and their limitations • identify, structure and solve problems also in new or emerging areas of their discipline • apply state-of-the-art and innovative methods in investigating and solving problems, drawing on other disciplines as appropriate • recognize the limits of current knowledge and technology and contribute to the further scientific and technological development of computer science • discuss current developments in computer science and assess their significance **Methodological competences** The students: • evaluate tools, technologies and methods and apply them in a differentiated manner • creatively develop new and original approaches and methods • reflect on problems also in new or emerging areas of their discipline and apply computer science methods to investigate and solve them **Social competences** The students: • integrate their skills into team processes **Self-competences** The students: • critically follow further developments in computer science in general and in their field of specialization • carry out innovative activities in their professional field successfully and independently
Module contents	See assigned course description
Recommended reading	As announced in course
Links	

Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	2 events from V, S, Ü, P

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Portfolio, presentation, written exam or oral exam The chosen form of examination will be announced in the first week of the course

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf589 - Special Topics in "Medical Informatics" II

Module label	Special Topics in "Medical Informatics" II
Module code	inf589
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Hein, Andreas (module responsibility) • Wulff, Antje (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No specific prior knowledge is required
Skills to be acquired in this module	The module aims to integrate current developments in the specialization area "Medical Informatics" into the course of study in the appropriate course forms. **Professional competences** The students: • differentiate and contrast a subfield of computer science in which they specialize in more detail or reflect on computer science in general • recognize and evaluate the techniques and methods to be used in their area of specialization and their limitations • identify, structure and solve problems also in new or emerging areas of their discipline • apply state-of-the-art and innovative methods in investigating and solving problems, drawing on other disciplines as appropriate • recognize the limits of current knowledge and technology and contribute to the further scientific and technological development of computer science • discuss current developments in computer science and assess their significance **Methodological competences** The students: • evaluate tools, technologies and methods and apply them in a differentiated manner • creatively develop new and original approaches and methods • reflect on problems also in new or emerging areas of their discipline and apply computer science methods to investigate and solve them **Social competences** The students: • integrate their skills into team processes **Self-competences** The students: • critically follow further developments in computer science in general and in their field of specialization • carry out innovative activities in their professional field successfully and independently
Module contents	See assigned course description
Recommended reading	As announced in the according course
Links	

Languages of instruction	German, English	
Duration (semesters)	1 Semester	
Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	2 events from V, S, Ü, P	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Portfolio, presentation, written exam or oral exam The chosen form of examination will be announced in the first week of the course

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf590 - Current Topics in 'Medical Informatics' I

Module label	Current Topics in 'Medical Informatics' I
Module code	inf590
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Wulff, Antje (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No specific prior knowledge is required.
Skills to be acquired in this module	The module aims to integrate current developments in the specialization area of "medical informatics" into the course of study in the appropriate course forms. **Professional competence** The students: • differentiate and contrast a subfield of computer science in which they specialize in more detail or reflect on computer science in general • recognize and evaluate the techniques and methods to be used in their area of specialization and their limitations • identify, structure and solve problems also in new or emerging areas of their discipline • apply state-of-the-art and innovative methods in investigating and solving problems, drawing on other disciplines as appropriate • recognize the limits of current knowledge and technology and contribute to the further scientific and technological development of computer science • discuss current developments in computer science and assess their significance **Methodological competences** The students: • evaluate tools, technologies, methods and procedures and apply them in a differentiated manner • investigate problems on the basis of technical and scientific literature, write an article according to scientific aspects and present their results in a scientific lecture • reflect on problems also in new or emerging areas of their discipline and apply computer science methods to investigate and solve them **Social competences** The students: • communicate convincingly orally and in writing **Self-competences** The students: • critically follow further developments in computer science in general and in their field of specialization • carry out innovative activities in their professional field successfully and independently
Module contents	See assigned course description

Recommended reading

As announced in course

Links		
Languages of instruction	German, English	
Duration (semesters)	1 Semester	
Module frequency	every term	
Module capacity	unlimited	
Teaching/Learning method	V or S	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Presentation or oral exam The chosen form of examination will be announced in the first week of the course

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf591 - Current Topics in 'Digitalized Energy systems'

Module label	Current Topics in 'Digitalized Energy systems'
Module code	inf591
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's programme Digitalised Energy Systems (Master) > Innovation Topics and Smart Grids
Responsible persons	• Nieße, Astrid (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirement
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methological competences** The students • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluateproblems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time, processes and resources **Social competences** The students • communicate with users and experts convincingly **Self competences** The students • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course description
Recommended reading	Will be announced in the course

Links		
Language of instruction	English	
Duration (semesters)	1 Semester	
Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	V or S	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Written exam or portfolio or presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	SuSe or WiSe
Workload attendance time	28 h

inf592 - Special Topics in 'Applied Artificial Intelligence' II

Module label	Special Topics in 'Applied Artificial Intelligence' II
Module code	inf592
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Sonntag, Daniel (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirement

Skills to be acquired in this module

The module aims to integrate current developments in the specialization area 'Learning and Cognitive Systems II' into the appropriate course formats within the study program.

Professioal competences
The students:

- differentiate and contrast a specific area of computer science in which they have specialized, in more detail, or reflect on computer science in general
- recognize and assess the techniques and methods applicable in their specialized field and their limitations
- identify, structure and solve problems also in new or emerging areas of their discipline
- apply state-of-the-art and innovative methods in investigating and solving problems, possibly drawing from other disciplines
- recognize the limits of current knowledge and technology and contribute to the further scientific and technological development of computer science
- discuss current developments in computer science and assess their significance

Methodological competencies
The students:

- valuate tools, technologies, and methods and apply them in a differentiated manner, creatively developing new and original approaches and methods
- reflect on problems, even in emerging areas of their discipline, and apply computer science methods to investigate and solve them

Social Competencies
The students:

- integrate their skills into team processes

Self-competences
The students:

- critically follow the further developments in computer science in general and in their specialized area
- successfully and independently carry out innovative activities in their professional field

Module contents

This module offers various classes in the field of Learning and Cognitive Systems. For details regarding objectives and content, please refer to the specific class or contact the instructor directly.

Recommended reading

will be announced in the assigned course

Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	2 events from V, S, Ü, P

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period by arrangement with the lecturer	Semester-long practical exercises or presentation or oral examination

Type of course	Course selection
SWS	2
Frequency	see frequency of module offering
Workload attendance time	56 h

inf593 - Special Topics in 'Applied Artificial Intelligence' I

Module label	Special Topics in 'Applied Artificial Intelligence' I
Module code	inf593
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Sonntag, Daniel (module responsibility) • Lehrenden, Die im Modul (Module counselling)
Prerequisites	No participant requirement
Skills to be acquired in this module	This module aims to integrate current developments in the specialization area "Learning and Cognitive Systems" I into the course of study in the appropriate course forms. **Professioal competences** The students: • differentiate and contrast a specific area of computer science in which they have specialized, in more detail, or reflect on computer science in general • recognize and assess the techniques and methods applicable in their specialized field and their limitations • identify, structure and solve problems also in new or emerging areas of their discipline • apply state-of-the-art and innovative methods in investigating and solving problems, possibly drawing from other disciplines • recognize the limits of current knowledge and technology and contribute to the further scientific and technological development of computer science • discuss current developments in computer science and assess their significance **Methodological competencies** The students: • valuate tools, technologies, and methods and apply them in a differentiated manner, creatively developing new and original approaches and methods • reflect on problems, even in emerging areas of their discipline, and apply computer science methods to investigate and solve them **Social Competencies** The students: • integrate their skills into team processes **Self-competences** The students: • critically follow the further developments in computer science in general and in their specialized area • successfully and independently carry out innovative activities in their professional field
Module contents	depending on the area of specialization and the assigned course
Recommended reading	depending on the area of specialization and the assigned course

Links		
Language of instruction		English
Duration (semesters)		1 Semester
Module frequency		irregular
Module capacity		unlimited
Teaching/Learning method		VA aus V, S, Ü, P
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period by arrangement with the lecturer.	Practical exercises and presentation or oral examination

Type of course	Course selection
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf596 - Special Topics in "Computational Intelligence" I

Module label	Special Topics in "Computational Intelligence" I
Module code	inf596
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Kramer, Oliver (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirement
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	See assigned course description, e.g. „Medizinische Bildverarbeitung“ or „Standard und Systeme für die Kommunikation in der Medizin“
Recommended reading	As announced in the according course
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester

Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	VA aus V, S, Ü, P	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf597 - Special Topics in "Computational Intelligence" II

Module label	Special Topics in "Computational Intelligence" II
Module code	inf597
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Kramer, Oliver (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirement
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	See assigned course description
Recommended reading	As announced in course
Links	
Language of instruction	German
Duration (semesters)	1 Semester

Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	events from aus V, S, Ü, P	

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf598 - Current Topics in 'Computational Intelligence' I

Module label	Current Topics in 'Computational Intelligence' I
Module code	inf598
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Kramer, Oliver (authorised to take exams) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirement
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course description
Recommended reading	As announced in course
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester

Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	V or S	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf599 - Current Topics in 'Computational Intelligence' II

Module label	Current Topics in 'Computational Intelligence' II
Module code	inf599
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Kramer, Oliver (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirement
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course description, e.g. „Kognitive Modellierung“, „KI und Wissensrepräsentation“
Recommended reading	As announced in course
Links	
Languages of instruction	German, English

Duration (semesters)		1 Semester
Module frequency		irregular
Module capacity		unlimited
Teaching/Learning method		V or S
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf604 - Business Intelligence I

Module label	Business Intelligence I
Module code	inf604
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master Applied Economics and Data Science (Master) > Data Science • Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) > Akzentsetzungsbereich • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Marx Gómez, Jorge (authorised to take exams) • Lehrenden, Die im Modul (authorised to take exams) • Bremer-Rapp, Barbara (module responsibility) • Solsbach, Andreas (module responsibility)
Prerequisites	No participant requirement
Skills to be acquired in this module	Objective of the module/skills: Current module provides basics of business intelligence with focus on enterprises and strong emphasis on data warehousing technologies. Students of the course are provided with knowledge, which reflects current research and development in a data analytic domain. **Professional competence** The students: • name and recognize the role of business intelligence as past of daily business process • being able to analyse advantages and disadvantages of different approaches and methods of the data analytics and being able to apply them in simple case studies • obtain theoretical knowledge about data collection and modelling processes, including most applicable approaches and best practices **Methodological competence** The students: • being able to execute typical tasks of business intelligence, and also being able to deepen knowledge on different approaches and methods • gain a hans on experience and being able to understand advantages and disadvantages of different methods and being able to use obtained knowledge in most efficient ways **Social competence** The students: • build solutions based on case studies given to the group, for example solving the issue of a factless fact table • discuss solutions on a technical level • present obtained case studies solutions as part of the exercises **Self-competence** The students: • critically review provided data and information
Module contents	

Data warehouse technology together with business intelligence are increasingly being used by business in order to get better decision support and enrich ongoing rocesses with data-rich decisions. Data warehouse technology enables an integration of data from heterogeneous sources, whether business intelligence builds data rocessing on top of it. For instance, business intelligence allows to build reporting on very large volumes of data (including historical) coming primary from data warehouse.
As past of the current module following contents are taught:

- Definition and scope of business intelligence.
- Procedures and objectives of data warehousing.
- Process of extracting, transforming and loading (ETL) of data.
- Phases of data modelling, data capturing and reporting in conjunction with a plausible case studies/scenarios.
- Prospects for further and evolving topics for business intelligence (e.g. Adaptive Business Intelligence, In-MemoryComputing. etc.)
- Introduction to Data Mining.
- Case studies based practical exercises and assessments in order to impart practical knowledge.

Recommended reading

- Gómez, J. M., Rautenstrauch, C., & Cissek, P. (2008). Einführung in Business Intelligence mit SAP NetWeaver 7.0. Springer Science & Business Media.
- Ariyachandra, T., & Watson, H. J. (2006). Which data warehouse architecture is most successful?. Business intelligence journal, 11(1), 4.
- Jensen, C., Pedersen, T. B., & Thomsen, C. (2010). Multidimensional databases and data warehousing. Morgan & Claypool Publishers.
- Haneke, U., Trahasch, S., Hagen, T., & Lauer, T. (2010). Open Source Business Intelligence: Möglichkeiten, Chancen und Risiken quelloffener BI-Lösungen. Hanser.
- Müller, R. M., & Lenz, H. J. (2013). Business intelligence. Berlin, Heidelberg: Springer Berlin Heidelberg.
- Sabherwal, R., & Becerra-Fernandez, I. (2013). Business intelligence: Practices, technologies, and management. John Wiley & Sons.
- Awe, O. W., Liu, R., & Zhao, Y. (2016). Analysis of energy consumption and saving in wastewater treatment plant: case study from Ireland. Journal of Water Sustainability, 6(2), 63-76.
- Adamson, C. (2010). The complete reference star schema. McGraw-Hill.
- Linstedt, D., & Olschimke, M. (2015). Building a scalable data warehouse with data vault 2.0. Morgan Kaufmann.
- Schnider, D., Jordan, C., Welker, P., & Wehner, J. (2016). Data warehouse blueprints: business intelligence in der Praxis. Carl Hanser Verlag GmbH Co KG.

Links

http://www.wi-ol.de

Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module	At the end of the lecture period	Written exam max. 120 minutes

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf607 - Business Intelligence II

Module label	Business Intelligence II
Module code	inf607
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master Applied Economics and Data Science (Master) > Data Science • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Marx Gómez, Jorge (authorised to take exams) • Lehrenden, Die im Modul (authorised to take exams) • Solsbach, Andreas (module responsibility) • Bremer-Rapp, Barbara (module responsibility)
Prerequisites	No participant requirement
Skills to be acquired in this module	Current module provides advanced business intelligence, data science with focus on enterprises and strong emphasis on big data and data analytics. Students of the course are provided with knowledge, which reflects current research and development in a data analytics domain. **Professional competence** The students: • name and recognize the role of data analytics / data science as past of a daily business process in a particular company • able to organize from managment perspective data analytis project • being able to analyse advantages and disadvantages of different approaches and methods of the data analytics and being able to apply them in simple case studies • obtain theoretical knowledge about data collection and modelling processes, including state of the art approaches and available best practices **Methodological competence** The students: • being able to execute typical tasks of data analytis, and also being able to proceed deeper with respect to different approaches and methods • gain a hans on experience and being able to understand advantages and disadvantages of different methods and being able to use obtained knowledge **Social competence** The students: • build solutions based on case studies given to the group, for example design of regression model based on provided dataset • discuss solutions on a technical level • present obtained case studies solutions as part of the exercises **Self-competence** The students: • critically review provided offered information
Module contents	

	After current course students will get advanced knowledge in the domains such as business intelligence and data analytics. Besides that, students will have a chance to have a deeper look into related technical fields such as InMemory Computing, Data Mining and Machine Learning, Big Data Processing with Distributed Systems (e.g. Apache Hadoop / Spark) from both, research and practical, perspectives. Students will be provided with real-world experience gather from business intelligence and data science related projects. Materials of the course are believed to be justified with current demands of data analytics market. Thus, providing students with relevant knowledge in order to give them advantages in future job.

Recommended reading

- Jürgen Cleve und Uwe Lämmel - Data Mining; Berlin/München/Boston: Walter de Gruyter GmbH, 2020 (German)
- Max Bramer (2013): "Principles of data mining" (English)
- Ian Witten, Eibe Frank, Mark Hall (2011): "Data mining : practical machine learning tools and techniques" (English)
- Jure Leskovec, Anand Rajaraman, Jeffrey Ullman (2014): "Mining of massive datasets" (English)
- Sebastian Raschka und Vahid Mirjalili - Python machine learning : machine learning and deep learning with Python, scikit-learn, and TensorFlow; Birmingham Mumbai: Packt Publishing, September 2017 (English)
- Aurélien Géron - Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow : concepts, tools, and techniques to build intelligent systems; Beijing Boston Farnham Sebastopol Tokyo: O'Reilly, September 2019 (English)

Links

http://www.wi-ol.de/

Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	Summer term
Module capacity	unlimited
Teaching/Learning method	V + Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module	At the end of the block course	Written examination or oral examination or term paper or referat or portfolio or practical exercises and written examination or practical exercises and oral examination.

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	28
Exercises		2	SuSe	28
Total module attendance time				56 h

inf650 - Transport Systems

Module label	Transport Systems
Module code	inf650
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Sauer, Jürgen (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Production-oriented business informatics
Skills to be acquired in this module	Objective of the module/skills: The Module Transport systems deals with planning and controlling systems of internal and external company logistics as well as public transport. It provides basic knowledge and recent research topics. The focus is on a resource orientated holistic view of company logistics as well as the planning of transport infrastructure. Furthermore, trends such as autonomous vehicles and intelligent transport systems are discussed. **Professional competence** The students: • name the basics of planning and controlling company logistics • assess transport systems of companies • name methods and approaches of computer aided transport systems and classify them • characterise software to plan complex logistics **Methodological competence** The students: • display topics and concepts of transport systems • simulate transport and its systems with appropriate methods **Social competence** The students: • work in groups • discuss their results appropriately **Self-competence** The students: • realise their limits while working on a project containing aspects of modelling and implementation • question the presentation of their results
Module contents	• Transport and logistics conpets • Data acquisition of company logistics • Planning- and simulation software for complex logistics- and transport processes • Energy- and resource efficient transport systems • Resource oriented transport cost calculations (e.g. CO2, noise

pollution)
- Planning models for transport infrastructure

Recommended reading

Suggested reading:

- Verkehrsdynamik und -simulation: Daten, Modelle und Anwendungen der Verkehrsflussdynamik von Martin Treiber und Arne Kesting von Springer, Berlin, 2010
- Produktion und Logistik (Springer-Lehrbuch) von Hans-Otto Günther und Horst Tempelmeier von Springer, Berlin (Taschenbuch - Juni 2009)

Links

http://wi-ol.de

Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module	At the end of the lecture period	Practical exercises and presentation

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	28
Exercises		2	SuSe	28
Total module attendance time				56 h

inf651 - Environmental Management Information Systems I

Module label	Environmental Management Information Systems I
Module code	inf651
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Administration, Economics and Law (Master) > Schwerpunktmodule NM - interdisziplinär • Master's programme Business Administration: Management and Law (Master) > Schwerpunktmodule NM - interdisziplinär • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Environmental Modelling (Master) > Mastermodule • Master's Programme Sustainability Economics and Management (Master) > Supplementary Modules
Responsible persons	• Marx Gómez, Jorge (module responsibility) • Bremer-Rapp, Barbara (module responsibility) • Solsbach, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirement
Skills to be acquired in this module	This module completes the knowledge and abilities gained in the field of Environmental Informatics and it creates a strong reference to up to date topics in the field of sustainability. The content taught in this module can directly be applied in an upcoming study and professional career. **Professional competence** The students: • are able to classify and explain the sustainability paradigm • are aware of the current status of sustainability reporting • are able to define and to model material flows • have obtained know-how in the field of corporate environmental management information systems (CEMIS) **Methodological competence** The students: • implement CEMIS • apply different techniques and methods to case studies • develop new case studies in teams **Social competence** The students: • are supposed to work in teams and therefore have to identify working packages and have to take on responsibility for the jobs assigned to them • present and discuss their own results with the team and the other members of the course **Self-competence** The students: • learn about their own limitations and learn to accept criticism in order to strengthen their own abilities
Module contents	This course teaches methods, approaches and techniques in the field of information processing in order to support solutions to problems that arise from companies' impact on the environment. In particular, ICT supported

	approaches of production-integrated environmental protection, environmental controlling and reporting are introduced and discussed. In order to enable the integration of such approaches into environmental protection, environmental management and its systems are taught as well. **The content in detail:** • environmental management as a basis for sustainability • sustainability and material flow management • strategic environmental management • eco-controlling life cycle • characteristics and system architectures of CEMIS • standard software systems • environmental accounting systems
Recommended reading	• Heck, P., Bemmann, U. (Hrsg.) (2002): Praxishandbuch Stoffstrommanagement. Deutscher Wirtschaftsdienst. • Rüdiger, C. (2000): Betriebliches Stoffstrommanagement. Deutscher Universitätsverlag. • Möller, A. (2000): Grundlagen stoffstrombasierter Betrieblicher Umweltinformationssysteme. Projekt Verlag. • Rautenstrauch, C. (1999), Betriebliche Umweltinformationssysteme, Springer-Verlag, Berlin.
Links	
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	exercises and written exam or exercises and oral exam The specific type of exam will be specified prior to the beginning of the course.

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	28
Exercises		2	SuSe	28
Total module attendance time				56 h

inf652 - Production-oriented Business Informatics

Module label	Production-oriented Business Informatics
Module code	inf652
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Sauer, Jürgen (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirement

Skills to be acquired in this module

The module deepens the contents of the modules „Wirtschaftsinformatik“ and „Wirtschaftsinformatik/Informationsmanagement“. The students will be able to contextualise IT systems and their functions in companies. They are able to participate in the implementation of IT systems in companies. The students know the essential tasks of materials management, production planning and controlling, warehousing, acquisition and supply chain management.

Professional competence

The students:

- name and differentiate the basics of business informatics and information management
- classify IT´systems and their functions in companies
- name and characterise the the essential tasks of materials management, production planning and controlling, warehousing, acquisition and supply chain management

Methodological competence

The students:

- transfer a holistic development process of production planning and control
- implement IT systems in businesses

Social competence

The students:

- participate in implementing IT systems in companies
- construct and present computational solutions to groups and within their work group
- integrate professional and objective criticism in their own and others' results

Self-competence

The students:

- recognize the planning horizon for IT systems
- reflect their role and skills to implement IT systems in businesses

Module contents

The module "Production-oriented Business Informatics" deals especially with production planning and control processes affected by process planning tasks, as well as classic problems of industrial production. The lecture is focussed on the application of information systems in industrial production companies. Priorities are order flow business processes and PPS-/ERP-Systems. Case studies and demonstrations illustrate the application of these systems.

Recommended reading

- Kurbel, Karl: Produktionsplanung und -steuerung im Enterprise Resource Planning und Supply Chain Management, Oldenbourg Verlag, 2005
- Further literature will be announced in the lecture

Links	
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Practical exercises and presentation

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		3	SuSe	42
Exercises		1	SuSe	14
Total module attendance time				56 h

inf653 - ERP Technologies

Module label	ERP Technologies
Module code	inf653
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) > Akzentsetzungsbereich • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Marx Gómez, Jorge (module responsibility) • Bremer-Rapp, Barbara (module responsibility) • Solsbach, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirement
Skills to be acquired in this module	Learning objectives Generation of understandings into the working approaches and tasks of ERP systems Examing components of ERP systems Generating knowledge about important aspects of the operation processes of ERP systems, such as data storage and processing, user management, and system maintenance. **Professional competence** • The students: • describe ERP systems in compliance with functions and technologies • identify state-of-the-art and future architectures of ERP systems • discuss the usage of core technologies (also in practical case studies, for example with SAP NetWeaver) **Methodological competence** • The students: • categorize fundamental technologies in combination with other enterprise-wide information systems • apply the presented methods in practical contexts **Social Competence** The students: • construct solutions to given problems in groups • present solutions to computing science problems before groups **Self-competence** The students: • recognize the limit of their capacity in implementing and customizing of business application systems
Module contents	The module provides the following content: • Overview of the components of ERP systems and their functionality and administration • In-depth analysis of ERP system architecture under consideration of surface structures and user • management in ERP systems, with focus on of data storage, particularly the used data models and database structures, backup and recovery strategies • Deployment of ERP applications in form of application service

providing, including the technical characteristics of this business model, especially Special Administration, delimitation and monitoring tasks for systems, which at the same time be provided several customers

- Lecture will be acccompanied by SAP case studies.

Recommended reading

- Norbert Gronau (2014) Enterprise Resource Planning – Architektur, Funktionen und Management von ERP-Systemen, 3. Aufl., De Gruyter Oldenbourg, München.
- Alexandra Kees (2015) Open Source Enterprise Software – Grundlagen, Praxistauglichkeit und Marktübersicht quelloffener ERP-Systeme, Springer Vieweg, Berlin Heidelberg.
- Leiting, A. (2012). Unternehmensziel ERP-Einführung: IT muss Nutzen stiften. Springer-Verlag.
- Osterhage, W. (2014) ERP-Kompendium – Eine Evaluierung von Enterprise Ressource Planning Systemen, Springer Vieweg, Berlin Heidelberg.
- Rainer Weber (2012) Technologien von Unternehmenssoftware – Mit SAP-Beispielen, Springer Vieweg, Berlin Heidelberg.
- Schubert, P., Winkelmann, A. (2023) Betriebswirtschaftliche Anwendungssysteme: Enterprise Resource Planning. Wiesbaden: Springer Fachmedien Wiesbaden.
- Nico Brehm, Jorge Marx Gómez (2007) Web Service-Based Specification and Implementation of Functional Components in Federated ERP-Systems, Springer Verlag, Berlin Heidelberg.
- Christian Schawel und Fabian Billing (2018): Morphologischer Kasten. In Top 100 Management Tools: Das wichtigste Buch eines Managers Von ABC-Analyse bis Zielvereinbarung (S. 219–221).
- Karsten Sontow, Peter Treutlein, Rainer Sontow (2016) ERP in der Praxis -Anwenderzufriedenheit, Nutzen & Perspektiven 2016/2017, Trovarit AG.
- Paul Alpar, Rainer Alt, Frank Bensberg, Heinz L. Grob, Peter Weimann, Robert Winter (2016) Anwendungsorientierte Wirtschaftsinformatik – Strategische Planung, Entwicklung und Nutzung von Informationssystemen, 8. Aufl., Springer Vieweg, Wiesbaden.

Links	
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	End of lecture period	Portfolio or practical exercises and written exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf654 - Mobile Commerce

Module label	Mobile Commerce
Module code	inf654
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) > Akzentsetzungsbereich • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Marx Gómez, Jorge (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirement
Skills to be acquired in this module	Professional competence The students: • define and encompass MC • explain the development stages of MC • are aware of the current developments within MC and are able to classify them • get to know technical essentials, functionalities and standards of wireless ICT • assess the fields of application and limitations of wireless ICT • examine the relevant mobile devices and their respective operating systems, know their characteristics and evaluate their fields of application • examine market participants, assess business models, optimize business processes • gain insight into specifics via examples and exercises **Methodological competence** The students: • get to know security aspects and specifics of mobile application design • prototypically develop an Android application • prepare and give presentations • develop a concept of a business model for an Android application **Social competence** The students: • work on their project in groups of three **Self-competence** The students: • reflect their own group-dynamic activities in respect of a mutual goal (successfully finish their project)
Module contents	See above
Recommended reading	• Turowski, K.; Pousttchi, K.: Mobile Commerce – Grundlagen und Techniken. 1. Aufl., Springer, Heidelberg 2004 • Also all materials provided within the lecture

Links		
Language of instruction	German	
Duration (semesters)	1 Semester	
Module frequency	annual	
Module capacity	unlimited	
Teaching/Learning method	V+Ü	

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	After the lecture	Portfolio

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf655 - IT-Controlling

Module label	IT-Controlling
Module code	inf655
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Marx Gómez, Jorge (module responsibility) • Solsbach, Andreas (module responsibility) • Bremer-Rapp, Barbara (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	
Skills to be acquired in this module	This module emphasizes the importance of IT-Controlling within an enterprise. The students gain knowledge on practically orientated technologies in order to leave a better understanding for the application and conversion possibilities of IT-Controlling. **Professional competence** The students: • name general tasks and functions of IT-Controlling. • recognize the importance strategical IT-Controlling applications. • learn strategies and methods of IT-Controlling. • identify the existence of an IT-Strategy as a pre condition of IT-Controlling. • know about the risks of IT-Outsourcing. • use IT-Controlling tools (e.g. information systems, portfolio analysis, benchmarking IT-Reporting). **Methodological competence** The students: • use their knowledge by independently compiled presentations on recent IT-Controlling subjects. **Social competence** The students: • discuss their results essentially and appropriately in this subject. • present their subjects to the group. **Self-competence** The students: • understand and analyse their own state of knowledge. • reflect their own effects on groups
Module contents	The employment of information technologies for enterprises is usually a key factor. By the change of our society to an information society, information gains more and more importance and takes a central role within ICT systems. The specifics of the ICT area cannot be supported by the classical economic controlling. The application of a strategical IT-Controlling becomes more and more important. The result of a study shows that in the meantime in about 80% of the German enterprises an ICT strategy was compiled. However, the study makes also clear, that about two out of three enterprises use no methods of strategical IT-Controlling. The new discipline of IT-Controlling provides plans and methods to avoid isolated applications.
Recommended reading	• Gadatsch, Andreas (2021): IT-Controlling: Von der IT-Kosten- und Leistungsverrechnung zum Smart-Controlling, 2., aktualisierte und erweiterte Auflage, Springer Vieweg • Gadatsch, Andreas, Mayer, Elmar (2014): Masterkurs IT-Controlling:

Grundlagen und Praxis für IT-Controller und CIOs, Balanced Scorecard, Portfoliomanagement, Wertbeitrag der IT, Projektcontrolling, Kennzahlen, IT-Sourcing, IT-Kosten- und Leistungsrechnung, 5., aktualisierte Auflage, Springer Vieweg
- Horváth, Péter, Gleich, Ronald und Seiter, Mischa (2020): Controlling, 14., komplett überarbeitete Auflage, Verlag Franz Vahlen
- Krcmar, H: Informationsmanagement. 6. Auflage. Springer Verlag, 2015
- Marx Gómez, Jorge, Junker, Horst und Odebrecht, Stefan (2009): IT-Controlling – Strategien, Werkzeuge, Praxis, Erich Schmidt Verlag

Links		
Language of instruction	German	
Duration (semesters)	1 Semester	
Module frequency	winter term	
Module capacity	unlimited	
Teaching/Learning method	V+Ü	
Previous knowledge	none	

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	usually within two weeks after the end of the lecture period	1 examination (Project oder Portfolio) or 2 examinations (Practical exercises and Written examination) specific type of examination will be announced prior to the beginning of the course

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf657 - Product Engineering

Module label	Product Engineering
Module code	inf657
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Sauer, Jürgen (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirement
Skills to be acquired in this module	Focus of this module is to learn and apply the product engineering process. A project will enable the students to design a product from the idea to the prototype. More specifically, a systematic, partial domain-specific, approach to solve technical problems and aspects of project management will be learned. Regular meetings are used to train the presentation capabilities of the students and to schedule working packages within the teams. **Professional competence** The students: • learn and try out the handling of virtual and physical prototypes • learn and try out the construction and validation of virtual prototypes with the aid of CAD-applications • learn and combine different basic development concepts from the mechanical engineering, microelectronics, control engineering and software engineering **Methodological competence** The students: • learn and try out project management concepts • learn and recognise the connections of different development concepts from different fields, e.g. mechanical engineering, control engineering, microelectronics and software engineering • develop own products with creativity techniques • schedule and organise the product development supported by project management techniques independently • learn the systematic refining of their own product idea with SysML • design and test products with state-of-the-art CAD-applications **Social competence** The students: • impart their structure and mode of action to other people • develop their own products in small teams • present their solutions to groups • integrate criticism to their solutions • support other groups by giving appropriate criticism **Self-competence** The students: • recognise and reflect their own limitations to get familiar and to plan a project in an unknown field (e.g. maritime construction/industries)
Module contents	

This module is a lecture accompanied by a hands-on project. The students work on one product development task. The product development starts with the idea-finding/brainstorming process which is used to create a digital product concept. During the semester a digital prototype will be created and validated by its initial requirements. Finally, a physical prototype is produced with a 3D-Printer (Rapid Prototyping). The progress of the project has to be documented and presented at different milestones.

Recommended reading	• Ehrlenspiel (2003): Integrierte Produktentwicklung • Ophey (2005): Entwicklungsmanagement. Methoden in der Produktentwicklung
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Reference text	The lecture material contains English parts
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module	At the end of the lecture period	Written exam or oral exam, or written documentation or Presentation or Porfolio

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf659 - Environmental Management Information Systems II

Module label	Environmental Management Information Systems II
Module code	inf659
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Administration, Economics and Law (Master) > Schwerpunktmodule NM - interdisziplinär • Master's programme Business Administration: Management and Law (Master) > Schwerpunktmodule NM - interdisziplinär • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Environmental Modelling (Master) > Mastermodule • Master's Programme Sustainability Economics and Management (Master) > Supplementary Modules
Responsible persons	• Marx Gómez, Jorge (module responsibility) • Bremer-Rapp, Barbara (module responsibility) • Solsbach, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	**recommended privious knowledge:** • The topics discussed in the modules inf651 Environmental Management Information Systems I as well as inf660 Sustainability Informatics, like material flow analysis, environmental management system, life cycle assessment, sustainability management.
Skills to be acquired in this module	This course aims at examining emerging research questions in the field of corporate environmental management information systems (CEMIS). After finishing this course, the students will have extensive knowledge regarding Business Environmental Informatics. In addition, they will be aware of recent research topics and challenges as well as relevant software solutions and practical projects. **Professional competence** The students: • will obtain extensive knowledge in the field of CEMIS • know emerging research questions and challenges as well as software solutions and projects **Methodological competence** The students: • find their own solutions or apply already existing approaches to new and unsolved questions in the field of CEMIS • capture required data, analyse it and present it to their team or the whole group **Social competence** The students: • are supposed to work in teams and therefore have to identify working packages and have to take on responsibility for the jobs assigned to them • present and discuss their own results with the team and the other members of the course **Self-competence** The students: • learn about their own limitations and learn to accept criticism in order to strengthen their own abilities

Module contents

A strong social pressure forces enterprises to question their current way of implementing their business and to include different aspects of sustainability into their strategies and operational actions. Such a rethinking of one's business is supported by corporate environmental management information systems. Such systems aim at optimising the energy and ressource usage, emission and waste minimisation as well as production integrated environmental protection. Of course they support the fulfillment of legal requirements such as waste management or hazardous material handling.
The module will cover:

- recent and emerging research questions and topics related to the field of CEMIS as well as Business Environmental Informatics.
- discussion and hands-on experience of standard software systems and newly established solutions.
- applying the knowledge obtained to the definition of new as well as on solving new case studies.

Recommended reading

- Marx Gómez, Jorge, Scholtz, Brenda (Hrsg.) (2016): Information Technology in Environmental Engineering. Springer International Publishing
- Marx Gomez, J., Sonnenschein, M., Vogel, U., Winter, A., Rapp, B., Giesen, N. (Hrsg.) (2016): Advances and New Trends in Environmental and Energy Informatics. Springer International Publishing
- Marx Gómez, J., Teuteberg, F. (Hrsg.) (2010): Corporate Environmental Management Information Systems – State of the Art and Future Trends. Idea Group Publishing Hershey (PA), London
- Heck, P., Bemmann, U. (Hrsg.) (2002): Praxishandbuch Stoffstrommanagement. Deutscher Wirtschaftsdienst
- Rüdiger, C. (2000): Betriebliches Stoffstrommanagement. Deutscher Universitätsverlag
- Möller, A. (2000): Grundlagen stoffstrombasierter Betrieblicher Umweltinformationssysteme. Projekt Verlag
- Rautenstrauch, C. (1999), Betriebliche Umweltinformationssysteme, Springer-Verlag, Berlin

Links

http://www.wi-ol.de

Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	WiSe
Module capacity	unlimited

Reference text

Usually, this course is offered as a block couse during the lecture free period. The specific type and language will be announced prior to the beginning of the course

Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module	In case the course is offered as block course, exams will be scheduled accordingly. Otherwise, usually within two weeks after the end of the lecture period	Written examination or Oral examination or Term paper/assignment or Formal presentation or Portfolio The specific type of exam will be announced prior to the beginning of the course.

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Exercises		2	WiSe	28
Total module attendance time				56 h

inf660 - Sustainability Informatics

Module label	Sustainability Informatics
Module code	inf660
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Marx Gómez, Jorge (module responsibility) • Solsbach, Andreas (module responsibility) • Bremer-Rapp, Barbara (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirement

Skills to be acquired in this module

After finishing this course, students should be able to set up a sustainabiliy report tailormade for different target groups for any kind of organization. The students will be enabled to know and apply different available standards and guidelines as well as to esti-mate the influence of data defects and the feasibility of recent information and communication technology. This course emphazizes the importance of sustainability reporting as a means of an organization's communca-tion (internal and external) and provides an overview on relevant indicators, standards and guidelines. Based on that the handling of data defects and missing data as well as different approaches of reporting will be dis-cussed. In addition, the specific requirements of different target groups regarding content and presentation of a report will be discussed as well.

Professional competence
The students:

- are aware of different indicators, standards and guidelines and know when to apply which.
- know different approaches of data capturing, interpolation of missing or corrupt data as well as the influence of each of these issues on the validity of a report.
- implement concepts for tailormade target group orientation.

Methodological competence
The students:

- prepare a small sustainability report based on their decision which standard or guideline to use.
- capture existing data and analyse it.
- prepare a tailormade target oriented presentation of their results.

Social competence
The students:

- are supposed to work in teams and therefore have to identify working packages and have to take on responsibility for the jobs assigned to them.
- present and discuss their own results with the team and the other members of the course

Self-competence
The students:

- learn about their own limitations and learn to accept criticism in order to strengthen their own abilities

Module contents

The following topics will be covered in this module:

- different definitions of the term sustainability.
- the importance of sustainability reporting as a means of an organisation's communication.
- LCA, environmental accounting, supply chain management as data sources.
- semantic, comparability and transformation of indicators, standards and guidelines.
- interpolation and interpretation of data defects.
- how to report (e.g. knowledge management, document engineering, integrated reporting, different target groups).

Recommended reading

- Marx Gómez, J., Teuteberg, F. (Hrsg.) (2010): Corporate Environmental Management Information Systems – State of the Art and Future Trends. Idea Group Publishing Hershey (PA), London
- Heck, P., Bemmann, U. (Hrsg.) (2002): Praxishandbuch Stoffstrommanagement. Deutscher Wirtschaftsdienst.
- Rüdiger, C. (2000): Betriebliches Stoffstrommanagement. Deutscher Universitätsverlag.
- Möller, A. (2000): Grundlagen stoffstrombasierter Betrieblicher Umweltinformationssysteme. Projekt Verlag.
- Rautenstrauch, C. (1999), Betriebliche Umweltinformationssysteme, Springer-Verlag, Berlin
  Brugger, F. (2010). Nachhaltigkeit in der Unternehmenskommunikation: Bedeutung, Charakteristika und Herausforderungen. Springer-Verlag.
- Kern, E., (2015). Kommunikationsmöglichkeiten für Aspekte der Nachhaltigkeitsinformatik. In: Cunningham, D. W., Hofstedt, P., Meer, K. & Schmitt, I. (Hrsg.), INFORMATIK 2015. Bonn: Gesellschaft für Informatik e.V., (S. 345-354).
- Mast, C. (2018). Unternehmenskommunikation. 7. Auflage.
- Naumann S. (2007). Nachhaltigkeitsinformatik: Ein neues Teilgebiet der angewandten Informatik? In: Rundbrief des Fachausschuss 4.6 Informatik und Umweltschuss der Gesellschaft für Informatik e. V. (Hrsg.): Informatik im Umweltschutz, Nr. 41, Juli 2007.
- Rubik F., Müller R., Harnisch, R., Holzhauer B., Schipperges M., Geiger S. (2019). Umweltbewusstsein in Deutschland 2018, Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit (BMU).
- Stolze, C., Rah, N., Thomas, O. (2011). Entwicklung eines integrativen Reifegradmodells für nachhaltige IT. In GI-Jahrestagung 2011.
- Hildebrandt, A., Kästle, S. (2017). Richtiges Nachhaltigkeitsmanagement in Zeiten des digitalen Wandels. https://doi.org/10.1007/978-3-662-53202-7_20

Links

http://vlba.wi-ol.de

Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	Winter term
Module capacity	unlimited
Teaching/Learning method	V+Ü or P

Examination	Prüfungszeiten	Type of examination
Final exam of module	At the end of the lecture period	Portfolio or project.

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	28
Exercise or practical training		2	SuSe	28
Total module attendance time				56 h

inf661 - Digital Transformation

Module label	Digital Transformation
Module code	inf661
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Marx Gómez, Jorge (module responsibility) • Bremer-Rapp, Barbara (module responsibility) • Solsbach, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements

Skills to be acquired in this module

After successful completion of the lecture, the students should be able to define enabler and actors of a digi-tal transformation within the context of a model company. Furthermore, key competences such as Cloud Computing or IoT are used to make potential exploitation by new digital business models visible. The results will be evaluated. The lecture explains basic properties of a digital transformation for companies and shows specific develop-ment potential. By forming and building a model company, students are able to create a realistic and practical scenario. A final documentation reveals the degree of fulfilment and the students point ov view on the scenario.
Professional competence
The students:

- recognize basic properties and facts of a digital transformation for companies
- devide different terms of digital transformation
- expose actual introduction projects
- compile practical knowledge by dividing goals of enabler and acteurs of a digital transformation
- obtain basic knowledge of key competences such as IT-Security, Data Analytics, Big Data, Cloud Computing
- identify digital business models within the specific development potential

Methodological competence
The students:

- etermine and analyse required information
- prepare the given information for specific target groups
- destablish an analytical understanding of digital enterprise structures within key competences and applications

Social competence
The students:

- work in groups, identify work packages and take on responsibility for the jobs assigned to them
- discuss and introduce the results on a functional level

Self-competence
The students:

- reflect their actions on the basis of self defined objectives
- analyse their own state of knowledge

Module contents

Within the lecture the upcoming topics are discussed:

- definition and introduction of digital transformation
- success factors, market changes and introductory projects
- enabler of a digtial transformation (competences, applications and structures)
- digital business models and networks - acteurs of a digital transformation
- industry 4.0 in the context of a digital transformation

Recommended reading

- Kollmann, T., Schmidt, H. (2016): Deutschland 4.0: Wie die Digitale Transformation gelingt. Springer Gabler, Wiesbaden.
- Cole, T. (2017): Digitale Transformation: Warum die deutsche Wirtschaft gerade die digitale Zukunft verschläft und was jetzt getan werden muss! 2. erweiterte Auflage. Verlag Franz Vahlen, München.
- Schallmo, D. (2016): Jetzt digital transformieren: So gelingt die erfolgreiche Digitale Transformation Ihres Geschäftsmodells. Springer Gabler, Wiesbaden.
- Schallmo, D., Rusnjak, A., Anzengruber, J., Werani, T., Jünger, M. (2017): Digitale Transformation von Geschäftsmodellen: Grundlagen, Instrumente und Best Practices. Springer Gabler, Wiesbaden.

Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	usually within two weeks after the end of the lecture period	Formal presentation, Project oder Written examination specific type of examination will be announced in the first lecture

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	28
Exercises		2	SuSe	28
Total module attendance time				56 h

inf663 - Application Area Maritime

Module label	Application Area Maritime
Module code	inf663
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Hahn, Axel (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	Professional competences The students: • gain knowledge about ship handling and navigation and • learn to understand maritime transportation as a system of systems with systems on board for stability, propulsion and steering as for bridge resource management. • understand the latter as a mayor contribution to organize navigation as a hierarchical team concept of a safety critical sociotechnical system. • are aware of the special technical and physical challenges of navigation. **Methodological competences** The students: • can apply system engineering methods to describe, analyse and design maritime systems. By looking on maritime transporation the gain transferable knowledge on other cyber physical systems. • learned to how systems can deal with harsh environmental conditions in a resilient way. **Social competences** The students: • Maritime transportation is a mayor basis of a global economy. Typically, students do not have an understanding of these transportation systems nor their technical and systemic challenges. Therefore, the student knows the concepts of maritime transportation and its role in international transportation networks after finishing this module. **Self-Competences** The students: • Especially their competences cover an understanding as maritime transportation as a systems of system with high requirements on reliability, dependability and safety in combination with efficiency to be competitive in a global economy.
Module contents	The module consists of a lecture and an exercise part: Lecture: Maritime Transportation in global and local supply chains, Base concepts of ship handling and navigation, maritime system dynamics, bridge resource management, eNAvigation and high automation systems. Seminar: Covering aspects of maritime transportation

Recommended reading

- Bernhard Berking, Werner Huth (Herausgeber), Handbuch Nautik 1: Navigatorische Schiffsführung, Seehafen Verlag, 2010

Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+S

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Oral examination and homework

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe and WiSe	28
Seminar		2	SuSe and WiSe	28
Total module attendance time				56 h

inf690 - Special Topics in 'Business Informatics' I

Module label	Special Topics in 'Business Informatics' I
Module code	inf690
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Marx Gómez, Jorge (module responsibility) • Sauer, Jürgen (module responsibility) • Staudt, Philipp (module responsibility) • Solsbach, Andreas (module responsibility) • Bremer-Rapp, Barbara (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** • The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and • apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	See assigned course description
Recommended reading	As announced in course

Links		
Language of instruction		German
Duration (semesters)		1 Semester
Module frequency		irregular
Module capacity		unlimited
Teaching/Learning method		2 events from V, S, Ü, P
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf691 - Special Topics in 'Business Informatics' II

Module label	Special Topics in 'Business Informatics' II
Module code	inf691
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Marx Gómez, Jorge (module responsibility) • Sauer, Jürgen (module responsibility) • Staudt, Philipp (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field, especially with a focus on corporate environmental management information systems, in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and • apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	See assigned course description
Recommended reading	As announced in course

Links		
Language of instruction	German	
Duration (semesters)	1 Semester	
Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	events from V, S, Ü, P	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf692 - Special Topics in 'Business Informatics' III

Module label	Special Topics in 'Business Informatics' III
Module code	inf692
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Marx Gómez, Jorge (module responsibility) • Sauer, Jürgen (module responsibility) • Staudt, Philipp (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field, especially with a focus on business intelligence, in adequate study courses. **Professional competences** The students: - define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general - recognise and evaluate applied techniques and methods of their subject and are aware of their limits - identify, structure and solve problems/tasks, also in new or developing subject areas - apply state of the art and innovative methods to solve problems, if necessary from other disciplines - are aware of the current limits and contribute to the development of computer science research and technology - discuss and evaluate recent computer science developments **Methodological competences** The students: - evaluate and apply tools, technology and methods sophisticatedly - combine new and original approaches and methods creatively - evaluate problems/tasks, including new or developing subject areas of their discipline and apply - computer science methods for solutions and research **Social competences** The students: - support team process by their abilities **Self-competences** The students: - pursue the overall and special computer science development critically - implement innovative professional activities effectively and independently
Module contents	See assigned course description
Recommended reading	As announced in course
Links	
Language of instruction	German

Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	evetns form V, S, Ü, P

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf693 - Special Topics in 'Business Informatics' IV

Module label	Special Topics in 'Business Informatics' IV
Module code	inf693
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Marx Gómez, Jorge (module responsibility) • Sauer, Jürgen (module responsibility) • Staudt, Philipp (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and • apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	See assigned course description
Recommended reading	As announced in course

Links		
Language of instruction	German	
Duration (semesters)	1 Semester	
Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	events from V, S, Ü, P	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf694 - Current Topics in 'Business Informatics' I

Module label	Current Topics in 'Business Informatics' I
Module code	inf694
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Sauer, Jürgen (module responsibility) • Marx Gómez, Jorge (module responsibility) • Staudt, Philipp (module responsibility) • Solsbach, Andreas (module responsibility) • Bremer-Rapp, Barbara (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See description of the assigned course
Recommended reading	

	As announced in course	

Links		
Language of instruction	German	
Duration (semesters)	1 Semester	
Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	V or S	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf695 - Current Topics in 'Business Informatics' II

Module label	Current Topics in 'Business Informatics' II
Module code	inf695
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Marx Gómez, Jorge (module responsibility) • Sauer, Jürgen (module responsibility) • Staudt, Philipp (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field, especially with a focus on corporate environmental management information systems, in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** • The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course description
Recommended reading	As announced in course

Links		
Language of instruction	German	
Duration (semesters)	1 Semester	
Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	V or S	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf696 - Current Topics in 'Business Informatics' III

Module label	Current Topics in 'Business Informatics' III
Module code	inf696
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Marx Gómez, Jorge (module responsibility) • Sauer, Jürgen (module responsibility) • Staudt, Philipp (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field, especially with a focus on business intelligence, in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See description of the assigned course
Recommended reading	As assigned in course

Links		
Language of instruction	German	
Duration (semesters)	1 Semester	
Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	V or S	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf697 - Current Topics in 'Business Informatics' IV

Module label	Current Topics in 'Business Informatics' IV
Module code	inf697
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Marx Gómez, Jorge (module responsibility) • Sauer, Jürgen (module responsibility) • Staudt, Philipp (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See description of the assigned course
Recommended reading	As assigned in course

Links		
Language of instruction	German	
Duration (semesters)	1 Semester	
Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	V or S	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf701 - Computer Science Education II

Module label	Computer Science Education II
Module code	inf701
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Pflichtmodule • Master of Education Programme (Hauptschule and Realschule) Computing Science (Master of Education) > Mastermodule • Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) > Pflichtbereich • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Diethelm, Ira (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	Professional competence The students: • (re-)construct the knowledge of computer science by the method of didactical reduction • differentiate the development of computer science and evaluate this development with current trends for class • select computer science education approaches for lesson planning, organisation and implementation **Methodological competence** The students: • (re-)construct core concepts of lesson planning for computer science education requirements **Social competence** The students: • present self-developed lesson plans and lesson materials • discuss lesson plans regarding computer science education concepts • accept opinions and criticism • provide constructive feedback **Self-competence** The students: • adapt computer science education concepts for lesson planning • reflect on their self-perception with regard to the conception of computer science education
Module contents	The lecture will focus on the requirements and challenges of computer science education in grammar school (German: Gymnasium). **Main focus:** • Didactical (re-)construction of computer science knowledge, especially its didactical reduction • Didactical categorisation of computer science and the development, importance and evaluation of computer science in school • Scheduling, organisation and implementation of computer science in class
Recommended reading	• Humbert, Ludger: Didaktik der Informatik. Wiesbaden: B. G. Teubner,

2005

- Weitere Literatur wird in der Veranstaltung je nach thematischen Schwerpunkten bekannt gegeben

Links

http://elearning.uni-oldenburg.de

Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	S

Examination	Prüfungszeiten	Type of examination
Final exam of module	End of lecture period	Exercise and und 1 seminar paper or 1 oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Seminar		4	WiSe	56
Exercises		2	WiSe	0
Total module attendance time				56 h

inf705 - Practical in Computer Science Education

Module label	Practical in Computer Science Education
Module code	inf705
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Diethelm, Ira (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	Professional competence The students: • know hard- and software system engineering approaches and use them in practice • make a qualified and contextual choice of hard- and software designing approaches • characterise and consider challenges of soft- and hardware systems in education **Methodological competence** The students: • know engineering approaches and use them in new contexts • evaluate decision making concepts and use them in different domains **Social competence** The students: • cooperate with team members during the development process • recognize package tasks and resume their responsibilities • analyse team conflicts and resolve them • document the software development process in a team • moderate team meetings and decision making processes appropriately **Self-competence** The students: • reflect their self-perception with regard to the implementation of software systems
Module contents	A hard- or software system for education will be designed in this practical course. The requirements analysis of hard- or software systems and the dealing with customers are the main topics of this practical course.
Recommended reading	As announced in course
Links	
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	P

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the semester	Practical implementation, presentation and oral exam

Type of course	Practical training
SWS	4
Frequency	SuSe
Workload attendance time	56 h

inf710 - Special Topics in 'Computer Science Education' I

Module label	Special Topics in 'Computer Science Education' I
Module code	inf710
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Diethelm, Ira (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	See assigned course description
Recommended reading	As announced in course
Links	
Language of instruction	German
Duration (semesters)	1 Semester

Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	events from V, S, Ü, P	

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf711 - Special Topics in 'Computer Science Education' II

Module label	Special Topics in 'Computer Science Education' II
Module code	inf711
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Diethelm, Ira (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • evaluate and apply tools, technology and methods sophisticatedly • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research **Social competences** The students: • support team process by their abilities **Self-competences** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and independently
Module contents	See assigned course description
Recommended reading	As announced in course
Links	
Language of instruction	German
Duration (semesters)	1 Semester

Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	events from V, S, Ü, P

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Portfolio or presentation or oral exam

Type of course	Course selection
SWS	4
Frequency	see frequency of module offering
Workload attendance time	56 h

inf712 - Current Topics in Computer Science Education I

Module label	Current Topics in Computer Science Education I
Module code	inf712
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Pflichtmodule • Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) > Pflichtbereich • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Diethelm, Ira (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course description
Recommended reading	As announced in course

Links		
Language of instruction	German	
Duration (semesters)	1 Semester	
Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	V or S	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Written exam or portfolio or presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf713 - Current Topics in 'Computer Science Education' II

Module label	Current Topics in 'Computer Science Education' II
Module code	inf713
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Diethelm, Ira (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in the field in adequate study courses. **Professional competences** The students: • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competences** The students: • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research • schedule time processes and resources **Social competences** The students: • communicate with users and experts convincingly **Self-competences** The students: • pursue the overall and special computer science development critically • develop and reflect self-developed hypotheses to theories independently
Module contents	See assigned course description
Recommended reading	As announced in course
Links	
Language of instruction	German
Duration (semesters)	1 Semester

Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	V or S

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Presentation or oral exam

Type of course	Course or seminar
SWS	2
Frequency	see frequency of module offering
Workload attendance time	28 h

inf810 - Special Topics in Computer Science I

Module label	Special Topics in Computer Science I
Module code	inf810
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Computing Science (Master) > Informatik, allgemein • Master's Programme Environmental Modelling (Master) > Mastermodule
Responsible persons	• Peter, Andreas (module responsibility) • Marx Gómez, Jorge (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	The expected previous knowledge is specified in the details of the assigned course.
Skills to be acquired in this module	This module integrates current computer science developments into the business informatics program by appropriate study courses. **Professional competence** The students: • know recent technological or scientific computer science developments • transfer computer science methods and development models to IT application area requirements • evaluate the possibilities and limitations of computer science methods and tools and apply them appropriately **Methodological competence** The students: • review problems, formulate them with formal models and explore them appropriatel • identify and present (one or more) computer science problem solutions • select and evaluate appropriate tools and methods • examine problems with technical and scientific literature **Social competence** The students: • work in a team **Self-competence:** The Students: • plan their informatical actions independently
Module contents	According to the assigned course
Recommended reading	According to the assigned course

Links	
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Reference text	If more than one course is assigned to the module, you should generally select courses totalling 4 SWS, e.g. a lecture with an associated tutorial. Further information can be found in the description (details) of the assigned courses.
Teaching/Learning method	VA from V, Ü, S, P

Examination	Prüfungszeiten	Type of examination
Final exam of module		Portfolio or presentation or oral exam or written exam The concretely chosen form of examination will be announced in the respective assigned courses.

Type of course	Course selection
SWS	4
Frequency	SuSe or WiSe
Workload attendance time	56 h

inf811 - Special Topics in Computer Science II

Module label	Special Topics in Computer Science II
Module code	inf811
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Computing Science (Master) > Informatik, allgemein • Master's Programme Environmental Modelling (Master) > Mastermodule
Responsible persons	• Marx Gómez, Jorge (module responsibility) • Peter, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Useful background knowledge is specified in the details of the assigned course.
Skills to be acquired in this module	This module integrates current computer science developments into the business informatics program, especially considering the selected focus area, by appropriate study courses. **Professional competence** The students: • know recent technological or scientific computer science developments • transfer computer science methods and development models to IT application area requirement • evaluate the possibilities and limitations of computer science methods and tools and apply them appropriately **Methodological competence** The students: • review problems, formulate them with formal models and explore them appropriately • identify and present (one or more) computer science problem solutions • select and evaluate appropriate tools and methods • examine problems with technical and scientific literatur **Social competence** The students: • work in a team **Self-competence:** The Students: • lan their informatical actions independently
Module contents	According to the assigned course
Recommended reading	According to the assigned course
Links	
Language of instruction	German

Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Reference text	If more than one course is assigned to the module, you should generally select courses totalling 4 SWS, e.g. a lecture with an associated tutorial. Further information can be found in the description (details) of the assigned courses.
Teaching/Learning method	2 events from V, Ü, S, P

Examination	Prüfungszeiten	Type of examination
Final exam of module		Portfolio or formal presentation or oral exam or written exam The concretely chosen form of examination will be announced in the respective assigned courses.

Type of course	Course selection
SWS	4
Frequency	SuSe or WiSe
Workload attendance time	28 h

inf812 - Current Topics in Computer Science I

Module label	Current Topics in Computer Science I
Module code	inf812
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Computing Science (Master) > Informatik, allgemein • Master's Programme Environmental Modelling (Master) > Mastermodule
Responsible persons	• Fränzle, Martin Georg (module responsibility) • Marx Gómez, Jorge (module responsibility) • Peter, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Useful background knowledge is specified in the details of the assigned course.
Skills to be acquired in this module	This module integrates current computer science developments into the business informatics program by appropriate study courses. **Professional competence** The students: • know recent technological or scientific computer science developments • transfer computer science methods and development models to IT application area requirements • evaluate the possibilities and limitations of computer science methods and tools and apply them appropriately **Methodological competence** The students • review problems, formulate them with formal models and explore them appropriately • identify and present (one or more) computer science problem solutions • select and evaluate appropriate tools and methods • examine problems with technical and scientific literature **Social competence** The students: • work in a team **Self-competence:** The Students: • plan their informatical actions independently
Module contents	According to the assigned task
Recommended reading	According to the assigned task
Links	

Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Reference text	If more than one course is assigned to the module, you should generally select a seminar totalling 2 SWS Further information can be found in the description (details) of the assigned courses.
Teaching/Learning method	1 event from V, Ü, S, P, PR

Examination	Prüfungszeiten	Type of examination
Final exam of module		Written exam or portfolio or presentation or oral exam The concretely chosen form of examination will be announced in the respective assigned courses.

Type of course	Course selection
SWS	2
Frequency	--
Workload attendance time	28 h

inf813 - Current Topics in Computer Science II

Module label	Current Topics in Computer Science II
Module code	inf813
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Computing Science (Master) > Informatik, allgemein • Master's Programme Environmental Modelling (Master) > Mastermodule
Responsible persons	• Marx Gómez, Jorge (module responsibility) • Fränzle, Martin Georg (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current computer science developments into the business informatics program, especially considering the selected focus area, by appropriate study courses. **Professional competence** The students: • know recent technological or scientific computer science developments • transfer computer science methods and development models to IT application area requirements • evaluate the possibilities and limitations of computer science methods and tools and apply them appropriately **Methodological competenc** The students: • review problems, formulate them with formal models and explore them appropriately • Identify and present (one or more) computer science problem solutions • select and evaluate appropriate tools and methods • examine problems with technical and scientific literature **Social competence** The students: • work in a team **Self-competence:** The Students: • plan their informatical actions independently
Module contents	According to the assigned task
Recommended reading	According to the assigned task
Links	
Language of instruction	German
Duration (semesters)	1 Semester

Module frequency	every semester
Module capacity	unlimited
Reference text	If more than one course is assigned to the module, you should generally select a seminar totalling 2 SWS Further information can be found in the description (details) of the assigned courses.
Teaching/Learning method	1 event of V, Ü, S, P, PR

Examination	Prüfungszeiten	Type of examination
Final exam of module		Exercises or presentation or oral exam or written exam

Type of course	Course selection
SWS	2
Frequency	--
Workload attendance time	28 h

inf814 - Aktuelle Themen aus dem Gebiet "Safety-Security-Interaction" I

Module label	Aktuelle Themen aus dem Gebiet "Safety-Security-Interaction" I
Module code	inf814
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Computing Science (Master) > Informatik, allgemein
Responsible persons	• Peter, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Useful background knowledge is specified in the details of the assigned course.
Skills to be acquired in this module	This module integrates current computer science developments into the computer science Master program, especially considering the selected Master specialization, by appropriate study courses **Professional competence** The students: • know recent technological or scientific computer science developments • transfer computer science methods and development models to IT application area requirements • evaluate the possibilities and limitations of computer science methods and tools and apply them appropriately **Methodological competenc** The students: • analyze the technical merits of specific developments within the field of "Safety-Security-Interaction" • substantiate their analyses using existing and scientific documented knowledge • clearly write up those analyses in a concise scientific report • present their results in a scientific talk **Social competence** The students: • communicate persuasively orally and in writing • further develop an attitude in which being able to clearly explain matters is geared to optimize the quality of feedback **Self-competence** The students: • critically follow further developments in computer science in general and in their special field • develop and reflect on their own theories in relation to independently formulated hypotheses
Module contents	According to the assigned course/task
Recommended reading	Will be announced in the course
Links	
Language of instruction	English

Duration (semesters)	1 Semester	
Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	V or S	

Examination	Prüfungszeiten	Type of examination
Final exam of module		
		Portfolio or Presentation or oral exam or written exam The concretely chosen form of examination will be announced in the respective assigned courses.

Type of course	Seminar
SWS	0
Frequency	see frequency of module offering

inf815 - Aktuelle Themen aus dem Gebiet "Safety-Security-Interaction" II

Module label	Aktuelle Themen aus dem Gebiet "Safety-Security-Interaction" II
Module code	inf815
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Computing Science (Master) > Informatik, allgemein
Responsible persons	• Peter, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Useful background knowledge is specified in the details of the assigned course.
Skills to be acquired in this module	This module integrates current computer science developments into the computer science Master program, especially considering the selected Master specialization, by appropriate study courses **Professional competence** The students: • know recent technological or scientific computer science developments • transfer computer science methods and development models to IT application area requirements • evaluate the possibilities and limitations of computer science methods and tools and apply them appropriately **Methodological competenc** The students: • analyze the technical merits of specific developments within the field of "Safety-Security-Interaction" • substantiate their analyses using existing and scientific documented knowledge • clearly write up those analyses in a concise scientific report • present their results in a scientific talk **Social competence** The students: • communicate persuasively orally and in writing • further develop an attitude in which being able to clearly explain matters is geared to optimize the quality of feedback **Self-competence** The students: • critically follow further developments in computer science in general and in their special field • develop and reflect on their own theories in relation to independently formulated hypotheses
Module contents	According to the assigned course/task
Recommended reading	Will be announced in the course
Links	
Language of instruction	English

Duration (semesters)	1 Semester	
Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	V or S	

Examination	Prüfungszeiten	Type of examination
Final exam of module		
		Portfolio or Presentation or oral exam or written exam The concretely chosen form of examination will be announced in the respective assigned courses.

Type of course	Seminar
SWS	0
Frequency	see frequency of module offering

inf5100 - Digital Technology on Energy Markets

Module label	Digital Technology on Energy Markets
Module code	inf5100
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's programme Digitalised Energy Systems (Master) > Automation and Electrical Engineering
Responsible persons	• Staudt, Philipp (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current computer science developments into the informatics program, especially considering the selected focus area, by appropriate study courses **Professional competence** The students: • will be able to follow scientific work in the application area of digitalised energy markets, and thus be able to reflect on the current state of research in this area **Methological competence** The students: • are able to classify energy markets and judge new technological developments based on this classification **Social competence** The students: • create solutions in small teams • present and discuss their solutions • reflect the solutions of others in a constructive manner **Self competence** The students: • evaluate new technologies regarding their relevance for current energy-economic topics.
Module contents	In this module, theoretical concepts for understanding energy markets are presented and reflected with respect to the questions, how digitalisation of cyber-physical energy systems (CPES) is impacting the development of these markets. Fundamental concepts are discussed using easy-to-follow examples. These are: • Overview on Energy Markets • Consecutive markets and different time horizons • Smart Grids and energy markets • Push-effect of digital technologies on energy market development • Digitalised processes on energy markets • Market integration of renewable energy resources
Recommended reading	
Links	
Language of instruction	English

Duration (semesters)		1 Semester	
Module frequency		annual	
Module capacity		unlimited	
Teaching/Learning method		V+Ü	
Examination	Prüfungszeiten		Type of examination
Final exam of module			
	Following the event period		written exam or oral exam or

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf5104 - Fundamentals of Game Theory in Energy Systems

Module label	Fundamentals of Game Theory in Energy Systems
Module code	inf5104
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's programme Digitalised Energy Systems (Master) > Computer Science and Energy Informatics
Responsible persons	• Nieße, Astrid (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Useful prior knowledge: Fundamentals of optimization
Skills to be acquired in this module	Upon successful completion of the course, students can understand fundamental concepts of game theory, and the relevance of these concepts to applications in energy informatics research. **Professional competence** The students: • will be able to follow game-theoretic work in the application area of energy systems, and thus be able to reflect on the current state of research in this area **Methological competence** The students: can classify and formalise games and apply solution concepts for the presented types of games. Application examples can be examined for game types and the necessary simplifications can be evaluated. **Social competence** The students: • create solutions in small teams • present and discuss their solutions • reflect the solutions of others in a constructive manner **Self competence** The students: derive connections between everyday situations and their game theory conceptualization.
Module contents	In this module, theoretical concepts from game theory are prepared and presented with connections to the application in cyber-physical energy systems (CPES). Fundamental concepts are discussed using easy-to-follow examples. These are: • Game theory and decision theory • Interdependencies • Cooperative and non-cooperative game theory • Utility, discrete and continuous strategy, dominant strategy • Axioms of game theory • Theorems of game theory • Solution concepts for games, e.g. iterated elimination, backward induction • Multi-step and repeated games • Partial game perfection • Discont factor

- Mechanims design, markets and auctions

In CPES-application examples, references are made to distributed artificial intelligence and multi-agent systems, strategy learning, and operating in markets in energy applications

Recommended reading

- Dario Bauso: Game Theory with Engineering Applications. Society for Indstrial and Applied Mathematics, Philadelphia, 2016
- Shoham, Leyton-Brown: Multiagent systems. Cambridge University Press, 2010. http://www.masfoundations.org
- Fudenberg, Tirole: Game Theory. MIT Press, 1991

Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	every summer term
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module	Following the event period	Written exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	28
Exercises		2	SuSe	28
Total module attendance time				56 h

inf5106 - Optimal and Model-Predictive Control

Module label	Optimal and Model-Predictive Control
Module code	inf5106
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's programme Digitalised Energy Systems (Master) > Computer Science and Energy Informatics
Responsible persons	• Rauh, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	

Skills to be acquired in this module

The students identify fundamentals of the optimisation of control systems
Professional competence
The students:

- identify fundamentals of the optimisation of control systems
- characterise static and dynamic optimisation problems
- are aware of software implementations for selected test rigs

Methological competence
The students:

- analyse problems of optimal control
- generalise them independently toward novel research-oriented application scenarios

Social competence
The students:

- develop solution ideas for real control engineering tasks in small groups in a project/practical course accompanying the lecture
- communicate their results in short presentations

Self competence
The students:

- critically reflect the achieved results of their project work
- acknowledge limitations of various approaches for optimal control design

Module contents

1. Parameter optimization
    - Unconstrained optimisation
    - Optimisation under equality/ inequality constraints
2. Dynamic optimisation (structural optimisation)
    - Bellman’s optimality principle
    - Maximum principle of Pontryagin
    - Special optimisation problems: Minimum time problems, minimum energy, LQR
3. Linear model-predictive control
4. Nonlinear model-predictive control
5. Receding horizon state estimation

Recommended reading

- Anderson, B. D. O., Moore, J. B.: Linear Optimal Control. Prentice Hall, New Jersey, 1971.
- Föllinger, O.: Optimierung dynamischer Systeme. - Eine Einführung für Ingenieure.
- Oldenbourg-Verlag, München, 1985.
- Papageorgiou, M.; Leibold, M.; Buss, M.: Optimierung. Statische, dynamische, stochastische Verfahren für die Anwendung. 3. Aufl., Springer-Verlag, Berlin, 2012.
- Rauh, A. Folien/ Skript zur Vorlesung „Optimal and Model-Predictive

Control“.

Links		
Language of instruction		English
Duration (semesters)		1 Semester
Module frequency		every summer term
Module capacity		unlimited
Teaching/Learning method		V+Ü
Previous knowledge		Useful previous knowledge: Basic knowledge of control of linear continuous-time and/or discrete-time systems or robust control.

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	at the end of the lecture period	Portfolio or written exam; contents of portfolio will be announced at the beginning of the lecture period

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	28
Exercises		2	SuSe	28
Total module attendance time				56 h

inf5112 - Digitalised Energy System Modeling and Control

Module label	Digitalised Energy System Modeling and Control
Module code	inf5112
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's programme Digitalised Energy Systems (Master) > Digitalised Energy System Automation, Control and Optimisation
Responsible persons	• Lehnhoff, Sebastian (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements

Skills to be acquired in this module

After successful completion of the course the students should be able to understand the existing structures and technical basis of energy systems to produce, transfer and distribute electricity and their interaction and dependency on each other. They should have developed an understanding for necessary IT- and process control technology components, methods and processes to control and operate electrical energy systems. The students are able to estimate and evaluate the requirements and challenges of ICT and computer science which are caused by the development and integration of unforeseeable fluctuations of decentralised plants.
The students will be able to estimate the influence of distributed control concepts and algorithms for decentralised plants and consumers in the so called Smart Grid energy systems. Regarding the requirements, the students will be able to analyse the safety, reliability, realtime capability and flexibility of Smart Grid energy systems.

Professional competence
The students:

- understand the existing structures and the technical basis of energy systems producing, transferring and distributing electricity and their interaction and dependency on each other.
- develop an understanding for necessary IT- and process control technology components, methods and processes to control and operate electrical energy systems.
- estimate and evaluate the requirements and challenges of ICT and computer science, which are caused by the development, and integration of unforeseeable fluctuations of decentralised plants
- estimate the influence of distributed control concepts and algorithms for decentralised plants and
  consumers in the so called Smart Grid energy systems.

Methological competence
The students:

- analyse the safety, reliability, realtime capability and flexibility of Smart Grid energy systems
- use advanced mathemtical methods to calculate networks

Social competence
The students:

- create solutions in small teams
- discuss their solutions

Self competence
The students:

reflect their own use of the limited resource power

Module contents

In this course information technology, economical energy industry and technical basic knowledge and methods are analysed by using concrete Smart Grid approaches. The basic calculation methods for an intelligent net management are introduced.
This module deals with the technical and economical framework for a permissable electrical network as well as mathematical modelling and calculation methods to analyse conditions of electrical energy networks (in stationary conditions).

These are:

- the organisation of the EU energy market (regulatory framework, responsibility in liberalisation of electrical energy systems)
- Establishment and operation of electrical energy supply networks (network topology, statutory duties of supply, supply quality/system services, malfunctions and protection systems)
- Network calculation (complex vector representation, effective/idle power, mathematical performance models/net model, transformation: node performance to node voltage and electricity, calculation of conductive current, current flow, fix-point-iteration, Newton- Raphson-Method, voltage drop, transformer model)
- Intelligent network management (Smart Grids), Aggregation forms, machine learning approaches)

Recommended reading

- Konstantin, P.; Praxisbuch Energiewirtschaft, Springer 2006
- Schwab, A.; Elektroenergiesysteme, Springer 2009
- Kirtley, J.L.; Electric Power Principles, John Wiley & Sons, 2010
- Gremmel, H.; ABB Schaltanlagen-handbuch, Cornelsen 2007
- Lehnhoff, S.: Dezentrales vernetztes Energiemanagement, 2010
- Sutton, R.S.; Barto, A.G.: Reinforcement Learning, MIT Press 1998

Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	every summer term
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module	At the end of the event	written exam or oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		3	SuSe or WiSe	42
Exercises		1	SuSe and WiSe	14
Total module attendance time				56 h

inf5114 - Digitalised Energy System Requirements Engineering

Module label	Digitalised Energy System Requirements Engineering
Module code	inf5114
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's programme Digitalised Energy Systems (Master) > Digitalised Energy System Automation, Control and Optimisation
Responsible persons	• Lehnhoff, Sebastian (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements

Skills to be acquired in this module

The students will learn different approaches to integrate distributed generation, the regulatory framework, relevant standards and architecture concepts of energy management systems and they are able to apply this knowledge.
Professional competence
The students:

- develop and evaluate IT- Architectures for energy management
- model objects of this domain appropriately
- model energy information systems
- realise and differentiate advanced tasks of decentralised energy management

Methological competence
The students:

- name problems for the energy management, analyse these problems systematically and provide solutions
- apply different simulation approaches of decentralised plants and consumers

Social competence
The students:

- discuss solutions for the energy management together
- develop use cases in teams
- present self-developed solutions

Self competence
The students:

- reflect their actions with regarde to structure and decompose systems
- reflect their own use of the limited resource power

Module contents

This module provides the computer science basics for the energy management. It provides the requirements of energy supply information systems with the focus on technical components and the requirements of decentralised and renewable energy plants.
These are:

- Architectures for energy information systems, e.g. SOA, Seamless Integration Architecture (IEC TC 57), OPC-UA
- Norms and standards of energy industry data models(CIM, 61850)
- Systematisation of energy information system requirements based on ontologies
- Development, analysis and adaption of energy industry reference models and processes
- Methods and technologies to support energy industry processes
- Methods and algorithms to support decision processes of the decentralised energy plants control

- Smart Grid plants communication, the load management in particular
- Methods for modelling and simulation of power supply system dynamics

Recommended reading	• Crastan V.: "Elektrische Energieversorgung II", Springer 2004 • Heuck K., Dettman K. D., Schulz D.: "Elektische Energieversorgung I", 7. Aufl., Vieweg 2007 • Konstantin, P.: "Praxisbuch Energiewirtschaft", Springer 2006 • Schwab, A.: "Elektroenergiesysteme, Springer 2009
Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	every winter term
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the course	term paper

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		3	WiSe	42
Exercises		1	WiSe	14
Total module attendance time				56 h

inf5118 - Decentralised Nonlinear Model-Based Control in Digitalised Energy Systems

Module label	Decentralised Nonlinear Model-Based Control in Digitalised Energy Systems
Module code	inf5118
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's programme Digitalised Energy Systems (Master) > Digitalised Energy System Automation, Control and Optimisation
Responsible persons	• Rauh, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	
Skills to be acquired in this module	The students identify fundamentals of control and stateestimation for nonlinear systems. **Professional competence** The students: • identify fundamentals of control and state estimation for nonlinear systems • characterise problem-specific solution techniques • are aware of software implementations forselected test rigs **Methological competence** The students: • analyse problems of nonlinear control and state estimation and generalise them independently toward novel research-oriented applicationscenarios **Social competence** The students: • develop solution ideas for real-life control problems within an accompanying project/lab course in small teams • explain the obtained results inshort presentations **Self competence** The students: • critically reflect the achieved results of their project work • acknowledge limitations of various approaches fornonlinear control design.

Module contents	1. Fundamentals of control- oriented modelling
	2. Special properties of nonlinear control systems
	  ◦ Finite escape time
	  ◦ Chaos
	  ◦ Limit cycles
	  ◦ Equilibria
	3. Stability properties/ Stability analysis
	  ◦ Local vs. global Stability
	  ◦ Ljapunovmethods
	  ◦ Stability of limit cycles
	  ◦ Criteria for the proof of instability
	4. Nonlinear control design
	  ◦ Control Lyapunov functions
	  ◦ Beackstepping control
	  ◦ Feedback linearization
	  ◦ Flatness-based control
	5. Nonlinear observer synthesis

Recommended reading	• Föllinger, O.: Nichtlineare Regelungen 1 / 2. Oldenbourg-Verlag,

München, 1989. Adamy, J.: Nichtlineare Regelungen; Springer Verlag, 2009.

- Unbehauen, H.: Regelungstechnik II. 9. Aufl., Vieweg-Verlag, 2007. Marquez, H.: Nonlinear Control Systems, Wiley, 2003
- Khalil, H.K.: Nonlinear Systems, Pearson, 2001
- Rauh, A. Folien/ Skript zur Vorlesung „Decentralised Nonlinear Model-Based Control in DES“.

Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	every summer term
Module capacity	unlimited
Teaching/Learning method	V+Ü
Previous knowledge	Basic knowledge of the control of linear continuous-time and/or discrete-time systems or of robust control

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	portfolio or written exam; contents of portfolio will be announced at the beginning of the lecture period

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	28
Exercises		1	SuSe	28
Total module attendance time				56 h

inf5120 - Digitalised Energy System Co-Simulation

Module label	Digitalised Energy System Co-Simulation
Module code	inf5120
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's programme Digitalised Energy Systems (Master) > Digitalised Energy System Design and Assessment
Responsible persons	• Bremer, Jörg (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Programming mit Python, Simulation-based Smart Grid Engineering and Assessment

Skills to be acquired in this module

Successfully completing this lecture will enable the students to mathematically model simple controllable electrical generators and consumers and to simulate them together with appropriate control algorithms within smart grid scenarios. To achieve this goal, student will start with deriving computational models from physical models and by evaluating them. In order to manage the integration of control algorithms. Students are taught the principles of cosimulation using the example of the "mosaik" smart grid cosimulation framework.
Students are put into the position to understand and apply distributed, agent-based control schemes to decentralised energy generators and/or consumers. As a result, students are able to analyze the requirements for successful application to real power balancing regarding capacity utilization, robustness, and flexibility. In addition, students practically apply the foundations for planning and conducting simulation based experiments as well as the interpretation of the results. Attention is especially paid to a tradeoff between precision and robustness of the results and the necessary efforts (design of experiments) in order to gain as much insight into interdependencies with as few experiments.

Profesional competence
The student:

- derive and evaluate computational models from physical models
- use the "mosaik" smart grid cosimulation framework
- analyze the requirements for successful application to real power balancing regarding capacity utilization, robustness, and flexibility
- name the foundations for planning and conducting simulation based experiments as well as the interpretation of the results
- are aware to the tradeoff between precision and robustness of the results and the necessary efforts (design of experiments) in order to gain as much insight into interdependencies with as few experiments.

Methological competence
The student:

- model simple controllable electrical generators and consumers
- simulate simple controllable electrical generators and consumers with appropriate control algorithms within smart grid scenarios
- apply distributed agent-based control schemes to decentralised energy generators and/ or consumers
- evaluate simulation results
- search information and look into methods to implement models
- propose hyphothesis and ckeck their validity with simulation experiments

Social competence
The student:

- apply the development technique pair programming
- discuss design decisions
- identify work packages and take responsibility for it

Self-competence
The student:

- reflect on their own use of the limited resource power
- accept and use criticism to develop their own behaviour

Module contents

In this practical course students:

- mathematically model controllable, modulating electrical energy generators and consumers and translate them to executyble simulation models,
- put hands on mosaik (installation, description and configuration of scenarios, conduction of simulations),
- learn the principles of co-simulation of energy systems,
- learn about the challenges of implementing coordination mechanisms (multi-criticality, convergency, quality) on the training,
- apply foundations of design of experiments to practical simulation based experiments.

Recommended reading

Smart Grids:

- Konstantin, P.: "Praxisbuch Energiewirtschaft", Springer, 2006
- Schwab, A.: "Elektroenergiesysteme", Springer, 2009

Multiagentensysteme

- Sutton, R. S.; Barto, A. G.: "Reinforcement Learning", MIT Press, 1998-Weiss, G.: "Multiagent Systems", MIT Press, 2013
- Ferber J.; Kirn, S.: "Multiagentensysteme: eine Einführung in die Verteilte Künstliche lntelligenz", Addison-Wesley, 2001

Co-Simulation

- Ptolemaeus, C.: "System Design, Modeling, and Simulation", UC Berkeley, 2013
- Law, A.: "Simulation Modeling and Analysis", McGraw-Hill, 2015

Versuchsplanung

- Kleppmann, W.: "Versuchsplanung", Hanser, 2013
- Klein, B.: "Versuchsplanung - DoE", Oldenbourg, 2011
- Goos, P.; Jones, B.: "Optimal Design of Experiments", Wiley, 2014
- Box, G. E. P.; Hunter, J. S.; Hunter, W. G.: "Statistics for Experimenters", Wiley, 2005
- Forrester, A.; Sobester, A.; Keane, A.: "Engineering Design via Surrogate Modelling", Wiley, 2008

Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	every summer term
Module capacity	unlimited
Teaching/Learning method	PR

Examination	Prüfungszeiten	Type of examination
Final exam of module	At the end of the lecture time	Practikal Work A practical assignment includes the theoretical preparation, set-up and execution of a design task on the basis of a case study or the experiment as well as the written presentation of the work steps, the steps, the process and the results of the experiment and their critical evaluation.

Type of course	Project
SWS	4

Frequency	SuSe
Workload attendance time	28 h

inf5122 - Learning-Based Control in Digitalised Energy Systems

Module label	Learning-Based Control in Digitalised Energy Systems
Module code	inf5122
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's programme Digitalised Energy Systems (Master) > Digitalised Energy System Design and Assessment • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Rauh, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Basic knowledge of control of linear continuous-time and/or discrete-timesystems and/or robust control
Skills to be acquired in this module	The students identify fundamentals of learning-based control for dynamic systems. **Professional competences** The students: • identify fundamentals of learning-based control for dynamic systems • characterise problem- specific learning techniques • are aware of software implementations for selected test rigs. **Methological competences** The students: • analyse problems of learning-based control • generalise them independently toward novel research-oriented application scenarios. **Social competences** The students: • develop solution ideas for real-life control problems within an accompanying project/lab course in small teams • explain the obtained results in short presentations. **Self competences** The students: • critically reflect the achieved results of their project work • acknowledge limitations of various approaches for learning-based control design.

Module contents	1. Iterative learning control (ILC)
	    ◦ Grundlegende 2D-Systemstrukturen
	    ◦ Stability criteria
	    ◦ Ausgewählte Optimierungsansätze
	2. Data-driven neural network modelling vs. first-principle modelling
	    ◦ Static function approximations
	    ◦ NARX-modelling
	3. Design of neural network- based controllers
	4. Stability of neural network-based controllers

Recommended reading

- Moore, K.L. Iterative Learning Control for Deterministic Systems. London: Springer- Verlag. 1993
- Jian Xin Xu; Ying Tan. Linear and Nonlinear Iterative Learning Control. Springer- Verlag. 2003
- Bristow, D. A.; Tharayil, M.; Alleyne, A. G. "A Survey of Iterative Learning Control A learning-based method for high-performance tracking control". IEEE control systems magazine. Vol. 26. pp. 96–114. 2006
- The Mathworks Inc. Deep Learning Toolbox – Documentation, 2021
- Rauh, A. Folien/ Skript zur Vorlesung „Learning-Based Control in DES“

Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	every summer term
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the course	Portfolio or written exam; contents of portfolio will be announced at the beginning of the lecture period

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	28
Exercises		2	SuSe	28
Total module attendance time				56 h

inf5126 - Digitalised Energy System Cyber-Resilience

Module label	Digitalised Energy System Cyber-Resilience
Module code	inf5126
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's programme Digitalised Energy Systems (Master) > Innovation Topics and Smart Grids
Responsible persons	• Lehnhoff, Sebastian (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current developments in cyber resilience and its application to energy systems. **Professional competences** The students • recognise the entailed problems and challenges of new digitalization trends such as billion devices on the internet connected to our power grid (televisions, baby monitors, alexa, etc.), smart services, cloud services, outsourcing, Artificial Intelligence, Big Data etc. • evaluate fraud/ intrusion detection methods • identify security flaws and vulnerabilities of the energy system **Methological competences** The students • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems of cyber resilience in energy systems • schedule time processes and resources. **Social competences** The students • communicate with colleagues andexperts convincingly. **Self competences** The students • reflect the problems of cyber resilience of energy systems critically and pursue different possible solution strategies. • reflect self-developed hypotheses andtheories independently.
Module contents	• Energy system as critical infrastructure (KRITIS) • Propagation of phenomena and their dynamics • Omnipresent conflicts of objectives • Susceptibility of the energy system to new effects, such as the occurrence of "classic" IT challenges (errors, update management, interactions, …) and to sophisticated cyber-attacks
Recommended reading	Will be announced in the course

Links		
Language of instruction	English	
Duration (semesters)	1 Semester	
Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	V or S	

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	at the end of the lecture period	term paper

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		1	WiSe	14
Seminar		1	WiSe	14
Total module attendance time				28 h

inf5128 - AI in Energy Systems

Module label	AI in Energy Systems
Module code	inf5128
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's programme Digitalised Energy Systems (Master) > Innovation Topics and Smart Grids
Responsible persons	• Bremer, Jörg (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	The students learn to understand the energy system as self-organizing, self-optimizing and self-healing cyber physical system and how equip the components with of a cyber physical energy system with intelligence and autonomy **Professional competences** The students • contrast different methods of AI • define modern use cases of AI applications in energy systems • identify appropriate AI methods to achieve a given control goal in the energy system • evaluate risks and drawbacks of AI in energy systems • apply AI to selected problems **Methological competences** The students • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems of AI in energy systems • schedule time processes and resources **Social competences** The students • communicate with colleagues and experts convincingly **Self competences** The students • pursue and reflect the integration of AI into energy systems critically • reflect self-developed hypotheses to theories independently
Module contents	This module integrates current developments in artificial intelligence (AI) and its application to energy systems
Recommended reading	Will be announced in the corresponding course
Links	
Language of instruction	English
Duration (semesters)	1 Semester

Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	V or S	

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	at the end of the lecture period	term paper

Type of course	Course or seminar
SWS	2
Frequency	SuSe
Workload attendance time	28 h

inf5130 - Socio-technical Energy Systems

Module label	Socio-technical Energy Systems
Module code	inf5130
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's programme Digitalised Energy Systems (Master) > Innovation Topics and Smart Grids
Responsible persons	• Lehnhoff, Sebastian (module responsibility) • Bremer, Jörg (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	The students learn to consider human needs right from the beginning in the design process of Human Cyber Physical Energy Systems. A human- centered design is at the core as an approach to interactive systems development that aims to make systems usable and useful by focusing on the users; and to develop systems that are aware of (NOT rationally acting) humans when making decision. **Professional competences** The students • recognise the energy system as a human cyber physical system with a steadily growing degree of autonomy • identify the potential for conflict that arises when humans interact with cyber physical systems • model human-system-interaction • recognise, evaluate and contrast approaches to self-explaining AI **Methological competences** The students • examine tasks with technical and research literature, write an academic article and present their solutions academically • evaluate problems of socio-technical energy system • schedule time processes and resources **Social competences** The students • communicate with colleagues and experts convincingly **Self competences** The students • pursue the integration of humans and human behaviour into cyber physical energy systems critically • develop and reflect self-developed hypotheses to theories independently
Module contents	• Simulation (and prediction) of human behaviour and decisions • Modeling user behaviour in human cyber physical systems • Self-explaining and justifying AI
Recommended reading	Will be announced in the assigned course

Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Teaching/Learning method	V or S

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	at the end of the lecture period	term paper

Type of course	Course or seminar
SWS	2
Frequency	WiSe
Workload attendance time	28 h

inf5400 - Advanced Topics in Applied Deep Learning

Module label	Advanced Topics in Applied Deep Learning
Module code	inf5400
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Strodthoff, Nils (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	This module is intended for an advanced audience and requires a solid understanding of the fundamentals of Machine Learning. Experience in training deep neural networks is essential in this context.
Skills to be acquired in this module	Professional competence The students • have in-depth knowledge of selected application areas of deep learning. They are familiar with various solutions for problems in these areas, know their advantages and disadvantages, and can practically implement them and adapt them to their own issues. **Methodological competence** The students • independently develop theoretical and practical concepts with the help of in-person events, provided materials, and specialized literature. **Social competence** The students • can present solution approaches for problems in this area to the plenary and defend them in discussions. **Self-competence** The students • are able to assess their own subject-specific and methodological competence. They take responsibility for their competence development and learning progress and reflect on these independently. In addition, they independently work on learning content and can critically reflect on the content. **General competence goals** ++ knowledge of data science/ML methods and its foundations ++ ability to analyze problems, compare and select solution methods ++ formalizing problems mathematically, developing and implementing solutions, interpret their results + data management and infrastructure skills + data presentation & discussion + Scientific literature (reading & writing) + scientific communication skills (in particular with people outside the field of study)
Module contents	The thematic areas to be covered in various instantiations of the module include deep learning methods for time series analysis and deep unsupervised learning. This instatiation on deep generative models will two primary subjects: self-supervised learning and modern generative models. In the first part, we will examine the fundamental design

	principles (contrastive versus non-contrastive) underlying self-supervised learning algorithms. In the second part, we will explore applications of these principles to specific data modalities such as computer vision, natural language processing (including an extensive coverage of large language models) and audio/time series. Finally, the third part will focus on generative models, where we will cover a wide array of models, ranging from autoregressive models, variational autoencoders, and normalizing flows, to generative adversarial networks and (latent) diffusion models.
Recommended reading	
	> Prince, S. J. (2023). Understanding deep learning. MIT press. > Dawid, A. & LeCun, Y. (2023). Introduction to Latent Variable Energy-Based Models: A Path Towards Autonomous Machine Intelligence. Les Houches Summer School on Statistical Physics and Machine Learning in 2022 https://arxiv.org/abs/2306.02572

Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	jedes Wintersemester
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Written exam / oral exam / project work Active participation: handing in exercises.

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf5402 - Trustworthy Machine Learning

Module label	Trustworthy Machine Learning
Module code	inf5402
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Strodthoff, Nils (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Content requirements are basic theoretical knowledge in machine learning, practical programming knowledge in Python basic knowledge in deep neural network training.

Skills to be acquired in this module

Professional competence
The students

- have an overview of the various aspects that determine the quality of machine learning algorithms.
- are familiar with methods to measure different quality aspects and, if necessary, methods to enhance them, and they can implement and apply these methods.

Methodological competence
The students

- independently develop theoretical and practical concepts with the help of in-person events, provided materials, and specialized literature.

Social competence
The students

- can present solution approaches for problems in this area to the plenary and defend them in discussions.

Self-competence
The students

- are able to assess their own subject-specific and methodological competence. They take responsibility for their competence development and learning progress and reflect on these independently. In addition, they independently work on learning content and can critically reflect on the content.

General compentence goals
++ knowledge of data science/ML methods and its foundations
++ Ability to analyze problems, compare and select solution methods
+ formalizing problems mathematically, developing and implementing solutions, interpret
their results
+ knowledge of ethical, legal, security-related limitations
+ data presentation & discussion
+ Scientific literature (reading & writing)
+ scientific communication skills (in particular with people outside the field of study)

Module contents

Machine learning algorithms are increasingly being applied in a wide range of areas, particularly in safety-critical domains. However, the quality of these algorithms is rarely systematically examined. The focus of this event is on various quality dimensions for machine learning algorithms, especially deep

	neural networks. This ranges from performance measurement to interpretability/explainability (XAI), robustness (adversarial robustness, non-adversarial robustness, distribution shifts, OOD-detection), uncertainty quantification, fairness/bias, and privacy. The methods will be introduced theoretically in the lecture and practically implemented and applied in the exercises.
Recommended reading	As there is no single textbook that covers all topics in this lecture series, relevant specialized readings will be recommended throughout the course.
Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	Wintersemester
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture term	Written or oral Exam Active participation: Handing in exercises

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf5406 - Medical Data Analysis with Deep Learning

Module label	Medical Data Analysis with Deep Learning
Module code	inf5406
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Strodthoff, Nils (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	A basic theoretical understanding in machine learning, practical programming skills in Phyton, and basic knowledge in deep neural networks.
Skills to be acquired in this module	**Professional competence** The students • have an overview of the application areas of machine learning methods for analyzing medical data and can contextualize the issues within both the methodological and (bio)medical problem contexts. They are familiar with suitable algorithms and can apply them in practice. **Methodological competence** The students • independently develop theoretical and practical concepts with the help of in-person events, provided materials, and specialized literature. **Social competence** The students • can present solution approaches for problems in this area to the plenary and defend them in discussions. **Self-competence** The students • are able to assess their own subject-specific and methodological competence. They take responsibility for their competence development and learning progress and reflect on these independently. In addition, they independently work on learning content and can critically reflect on the content. **General competence goals** + knowledge of data science/ML methods and its foundations ++ Ability to analyze problems, compare and select solution methods ++ formalizing problems mathematically, developing and implementing solutions, interpret their results + Data management and infrastructure skills + data presentation & discussion ++ interdisciplinary knowledge, thinking & communication + scientific communication skills (in particular with people outside the field of study) + independent research, project and time management
Module contents	This module provides insights into state-of-the-art deep learning method for the analysis of medical data. We cover a broad spectrum of data modalities and applications and try to discuss both methodological knowledge as well as the necessary medical background knowledge. In particular, we cover physiological time series (ECG, EEG),

medical imaging
(histopathology, CXR, CT/MRI), audio data (e.g. from digital stethoscopes), electronic health
records, clinical text data as well as multimodal combinations of these data types. These
topics are complemented by methodological focal points that
are particularly relevant for medical data analysis, such as interpretability, imbalanced or
sparsely labeled data. The students are supposed to work towards a final project of their
choice during the second half of the course.

Recommended reading	For background reading, see Rajpurkar, P., Chen, E., Banerjee, O., & Topol, E. J. (2022). AI in health and medicine. Nature medicine, 28(1), 31-38. Relevant specialized readings will be recommended throughout the course.
Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	irregulary in summer term
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	at the end of the lecture period	50% daily project work, 50% either presentation or written report

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	28
Exercises		2	SuSe	28
Total module attendance time				56 h

inf5408 - Applied Deep Learning in PyTorch

Module label	Applied Deep Learning in PyTorch
Module code	inf5408
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering • Master's Programme Environmental Modelling (Master) > Mastermodule
Responsible persons	• Strodthoff, Nils (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Content prerequisites are basic theoretical knowledge in the field of machine learning and practical programming skills in Python.
Skills to be acquired in this module	**Professional competence** The students • have an overview of the components of deep learning frameworks • are familiar with application areas of deep learning methods across various data modalities, and common solution strategies and model architectures • can appropriately adapt deep learning methods to new problems in the respective domains and apply them independently. **Methodological competence** The students • independently develop theoretical and practical concepts with the help of in-person events, provided materials, and specialized literature. **Social competence** The students • can present solution approaches for problems in this area to the plenary and defend them in discussions. **Self-competence** The students • are able to assess their own subject-specific and methodological competence • take responsibility for their competence development and learning progress and reflect on these independently • independently work on learning content and can critically reflect on the content. **General competence goals:** ++ knowledge of data science/ML methods and its foundations ++ ability to analyze problems, compare and select solution methods + formalizing problems mathematically, developing and implementing solutions, interpret their results + data management and infrastructure skills + data presentation & discussion + scientific literature (reading & writing) + scientific communication skills (in particular with people outside the field of

study)

Module contents

This lecture provides a comprehensive introduction to contemporary Deep Learning methods, with a specific emphasis on their practical application. Concurrently, it serves as a primer for the widely-used PyTorch Deep Learning framework, assuming only a basic familiarity with Python. The course encompasses a wide range of prevalent machine learning tasks across various data types, including tabular, image, text, audio, and graph data. Throughout the course, we delve into the most crucial and up-to-date model architectures within these domains.
This encompasses convolutional neural networks, recurrent neural networks, and transformer models. The lecture is complemented by hands-on exercise sessions, where students will gain practical proficiency with PyTorch. Simultaneously, they will acquire practical insights to effectively apply contemporary deep learning methods within their specific fields of interest.

Recommended reading

- Raschka, S., Liu, Y. H., & Mirjalili, V. (2022). *Machine Learning with PyTorch and Scikit-Learn: Develop machine learning and deep learning models with Python*. Packt Publishing Ltd.
- Zhang, A., Lipton, Z. C., Li, M., & Smola, A. J. (2023). *Dive into deep learning*. Cambridge University Press.
- Prince, S. J. (2023). *Understanding deep learning*. MIT press.

Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	every winter term
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	at the end of the lecture period	Written / oral exam Active participation: Handing in exercises

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf5450 - Current topics in applied deep learning

Module label	Current topics in applied deep learning
Module code	inf5450
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Strodthoff, Nils (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	The seminar requires attending a foundational lecture in the field of Machine Learning and Deep Learning.
Skills to be acquired in this module	**Professional competence** The students • have an overview of selected current challenges in the field of applied deep learning, along with exemplary solution approaches, and can contextualize the latter within the broader methodological context. **Methodological competence** The students • can independently explore topics using current research literature and critically reflect upon them. **Social competence** The students • can present solution approaches for problems in this area to the plenary and defend them in discussions. **Self-competence** The students • are able to assess their own subject-specific and methodological competence. They take responsibility for their competence development and learning progress and reflect on these independently. In addition, they independently work on learning content and can critically reflect on the content.
Module contents	This seminar provides insights into selected methodological challenges in the field of applied deep learning. Depending on the instantiation of the module, different emphases will be placed, such as the modeling of long-range interactions or methods for improving the label efficiency of machine learning algorithms, e.g. through self-supervised learning.
Recommended reading	
Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	every winter term
Module capacity	unlimited
Teaching/Learning method	S

Examination	Prüfungszeiten	Type of examination
Final exam of module		

Examination	Prüfungszeiten	Type of examination
	at the end of the lecture period/ intermediate exams	oral exam / portfolio / presentation

Type of course	Seminar
SWS	2
Frequency	see frequency of module offering

inf5452 - Current Topics in Trustworthy Machine Learning

Module label	Current Topics in Trustworthy Machine Learning
Module code	inf5452
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Strodthoff, Nils (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	The seminar requires attending a foundational lecture in the field of Machine Learning and/or Deep Learning.
Skills to be acquired in this module	**Professional competence** The students • gain an exemplary overview of challenges and existing solution approaches in their respective problem domains and can contextualize these within the broader methodological context. **Methodological competence** The students • can independently explore topics using current research literature and critically reflect upon them. **Social competence** The students • can present solution approaches for problems in this area to the plenary and defend them in discussions. **Self-competence** The students • are able to assess their own subject-specific and methodological competence. They take responsibility for their competence development and learning progress and reflect on these independently. In addition, they independently work on learning content and can critically reflect on the content.
Module contents	This seminar provides insights into various aspects of trustworthy Machine Learning. Depending on the instantiation of the module, different focuses should be set, such as interpretability/explainability, uncertainty quantification, or robustness.
Recommended reading	
Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	every winter term
Module capacity	unlimited

Teaching/Learning method	S	
Examination	Prüfungszeiten	Type of examination
Final exam of module	at the end of the lecture period/ intermediate exams	oral exam / portfolio / presentation

Type of course	Seminar
SWS	2
Frequency	see frequency of module offering

inf5454 - Current Topics of Machine Learning in (bio-)medicine

<table>
<tr><td>Module label</td><td>Current Topics of Machine Learning in (bio-)medicine</td></tr>
<tr><td>Module code</td><td>inf5454</td></tr>
<tr><td>Credit points</td><td>3.0 KP</td></tr>
<tr><td>Workload</td><td>90 h</td></tr>
<tr><td>Applicability of the module</td><td>Master's Programme Computing Science (Master) > Angewandte Informatik</td></tr>
<tr><td>Responsible persons</td><td>Strodthoff, Nils (module responsibility)
Lehrenden, Die im Modul (authorised to take exams)</td></tr>
<tr><td>Prerequisites</td><td>Knowledge in the basics in the area of machine learning and / or deep learning
Previous knowledge is desirable, knowledge in the analysis of (bio)medical data is also advantageous</td></tr>
<tr><td>Skills to be acquired in this module</td><td>Professional competence
The students
gain an exemplary overview of application areas of machine learning in biomedicine and can contextualize the discussed topics within broader methodological and application contexts
Methodological competence
The students
can independently explore topics using current research literature and critically reflect upon them.
Social competence
The students
can present solution approaches for problems in this area to the plenary and defend them in discussions.
Self-competence
The students
are able to assess their own subject-specific and methodological competence. They take responsibility for their competence development and learning progress and reflect on these independently. In addition, they independently work on learning content and can critically reflect on the content.</td></tr>
<tr><td>Module contents</td><td>This seminar provides insights into various application contexts of machine learning methods, especially deep learning, in the (bio)medical field. Depending on the instantiation of the module, different emphases will be placed, such as current examples of machine learning methods for diagnostic support, analysis of multimodal data, and even the analysis of protein data.</td></tr>
<tr><td>Recommended reading</td><td>For background reading, see
Rajpurkar, P., Chen, E., Banerjee, O., & Topol, E. J. (2022). AI in health and medicine. Nature medicine, 28(1), 31-38.
Relevant specialized readings will be recommended throughout the course.</td></tr>
<tr><td>Links</td><td></td></tr>
<tr><td>Language of instruction</td><td>English</td></tr>
<tr><td>Duration (semesters)</td><td>1 Semester</td></tr>
</table>

Module frequency	every summer term	
Module capacity	unlimited	
Teaching/Learning method	S	

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	at the end of the lecture period/ mid-term exams	oral exam or portfolio or presentation

Type of course	Seminar
SWS	2
Frequency	SuSe
Workload attendance time	28 h

inf5456 - Applied AI - Multimodal-Multisensor Interfaces I: Foundations, User Modeling, and Common Modality Combination

Module label	Applied AI - Multimodal-Multisensor Interfaces I: Foundations, User Modeling, and Common Modality Combination
Module code	inf5456
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Sonntag, Daniel (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	basic concepts of Artificial Intelligence, Human-Computer Interfaces
Skills to be acquired in this module	Learning methods of multimodal interaction, learning Human-Computer Interaction concepts. **Professional competences** The students • work their way into the topic of multimodality (competence: basic concepts of multimodality, • develop an intuition for multimodal approaches, multimodal fusion techniques). **Methological competences** The students • prepare a term paper on a special topic in the field of multimodality (competence: quick comprehension, • structured literature review, precise expression). **Social competences** The students • choose a topic and interact with each other and the supervising person (competence: communication skills, enthusiasm, initiative) **Self competences** The students • work independently in a supervised setting (competencies: Personal responsibility, analytical thinking, organization, time management).
Module contents	We look at relevant theory and neuroscience foundations for guiding the development of high-erformance systems. We discuss approaches to user modeling, interface design that supports user choice, synergistic combination of modalities with sensors, and blending of multimodal input and output. We also highlight an in- depth look at the most common multimodal-multisensor combinations- for example, touch and pen input, haptic and non- speech audio output, and speech co-processed with visible lip movements, gaze, gestures, or pen input. A common theme throughout is support for mobility and individual differences among users-including the world's rapidly growing population of seniors.
Recommended reading	The Handbook of Multimodal-Multisensor Interfaces: Signal Processing, Architectures, and Detection of Emotion and Cognition - Volume 1 (https://dl.acm.org/doi/book/10.1145/3015783)

Links

	https://uol.de/aai/lehre

Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	regular
Module capacity	12
Teaching/Learning method	S

Examination	Prüfungszeiten	Type of examination
Final exam of module	at the end of the lecture period	oral exam or portfolio or presentation

Type of course	Seminar
SWS	2
Frequency	SuSe and WiSe

inf5458 - Applied AI - Multimodal-Multisensor Interfaces II: Signal Processing, Architectures, and Detection of Emotion and Cognition

Module label	Applied AI - Multimodal-Multisensor Interfaces II: Signal Processing, Architectures, and Detection of Emotion and Cognition
Module code	inf5458
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Sonntag, Daniel (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	basic concepts of Artificial Intelligence, Human-Computer Interfaces
Skills to be acquired in this module	Learning methods of multimodal interaction, learning Human-Computer Interaction concepts. **Professional competences** The students work their way into the topic of multimodality (competence: basic concepts of multimodality, develop an intuition for multimodal approaches, multimodal fusion techniques). **Methological competences** The students • prepare a term paper on a special topic in the field of multimodality (competence: quick comprehension, structured literature review, precise expression). **Social competences** The students • choose a topic and interact with each other and the supervising person (competence: communication skills, enthusiasm, initiative) **Self competences** The students • work independently in a supervised setting (competencies: Personal responsibility, analytical thinking, organization, time management).
Module contents	We begin with multimodal signal processing, architectures, and machine learning. It includes recent deep-learning approaches for processing multisensorial and multimodal user data and interaction, as well as context-sensitivity. A further highlight is processing of information about users' states and traits, an exciting emerging capability in next-generation user interfaces. We discuss real-time multimodal analysis of emotion and social signals from various modalities and perception of affective expression by users. Then we discuss multimodal processing of cognitive state using behavioral and physiological signals to detect cognitive load, domain expertise, deception, and depression. This collection of chapters provides walk- through examples of system design and processing, information on tools and practical resources for developing and evaluating new systems, and terminology, and tutorial support for mastering this rapidly expanding field. Finally, we look at experts' exchange views on the timely and controversial challenge topic of multimodal deep learning. The discussion focuses on how multimodal-multisensor interfaces are most likely to advance human performance during the next decade.
Recommended reading	

	The Handbook of Multimodal-Multisensor Interfaces: Signal Processing, Architectures, and Detection of Emotion and Cognition - Volume 2 (https://dl.acm.org/doi/book/10.1145/3107990)
Links	https://uol.de/aai/lehre
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	every term
Module capacity	unlimited
Teaching/Learning method	S

Examination	Prüfungszeiten	Type of examination
Final exam of module	at the end of the lecture period	oral exam or portfolio or presentation

Type of course	Seminar
SWS	2
Frequency	SuSe and WiSe
Workload attendance time	28 h

inf5460 - Applied AI - Multimodal-Multisensor Interfaces III: Language Processing, Software, Commercialization, and Emerging Directions

Module label	Applied AI - Multimodal-Multisensor Interfaces III: Language Processing, Software, Commercialization, and Emerging Directions
Module code	inf5460
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Sonntag, Daniel (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	basic concepts of Artificial Intelligence, Human-Computer Interfaces
Skills to be acquired in this module	Learning methods of multimodal interaction, learning Human-Computer Interaction concepts. **Professional competences** The students work their way into the topic of multimodality (competence: basic concepts of multimodality, develop an intuition for multimodal approaches, multimodal fusion techniques **Methological competences** The students • prepare a term paper on a special topic in the field of multimodality (competence: quick comprehension, structured literaturereview, precise expression). **Social competences** The students • choose a topic and interact with each other and the supervising person (competence: communication skills, enthusiasm, initiative) **Self competences** The students • work independently in a supervised setting (competencies: Personal responsibility, analytical thinking, organization, time management)
Module contents	This third seminar takes the contents of the first two seminars— namely, the motivations, foundational concepts, basic modality combinations, component analyses, and recognition and fusion techniques—to the next level. MMI 3 discusses how to design and build functioning multimodal-multisensor systems that can sustain real-world use. This seminar is most appropriate for graduate students and of primary interest to students studying computer science and information technology, human-computer interfaces, mobile and ubiquitous interfaces, affective and behavioral computing, machine learning, and related multidisciplinary majors. It is very useful if you want to work on practical applications, transfer of AI technology to application domains such as medicine and healthcare, and industrial prototypes. Afterward, students might engage in a hands-on project in which they design, build, and evaluate the performance of a multimodal system in our project group MMI II (https://elearning.uni-oldenburg.de/dispatch.php/course/details?sem_id=098bd500a63e723551364c7f921755b5&again=yes).

Recommended reading	The Handbook of Multimodal-Multisensor Interfaces: Language Processing, Software, Commercialization, and Emerging Directions - Volume 3" (https://dl.acm.org/doi/book/10.1145/3233795).
Links	https://uol.de/aai/lehre
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	every term
Module capacity	unlimited
Teaching/Learning method	S

Examination	Prüfungszeiten	Type of examination
Final exam of module	at the end of the lecture period	oral exam or portfolio or presentation

Type of course	Seminar
SWS	2
Frequency	SuSe and WiSe

inf6602 - Sustainable Information Systems

Module label	Sustainable Information Systems
Module code	inf6602
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Staudt, Philipp (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Programming experience is an advantage but not necessary

Skills to be acquired in this module

- Understanding of Green Information Systems concepts and related theories
- Overview of sustainability topics in information systems research
- Understanding of the basics of decision support systems and ability to develop decision support systems in an environmental context
- Research methods in IS research in Green IS

Professional competences

The students

- know about the role of information systems research insustainability questions
- know how to use information systems to control sustainability in companies
- have an overview of the use cases for decision support tools in sustainability questions

Methological competences
The students

- are able to build decision support tools for sustainability purposes
- know how to apply Design Science Research techniques
- are able to build online experiments using otree
- are able to generate research results based on case studies or surveys

Social competences

The students

- improve their teamwork competencies in group exercises
- improve their presentation skills through exercise

Self competences
The students

- improve their time management through submission deadlines
- lean about the role and importance of energy markets for society

Module contents

Green Information Systems, Information Systems Theory, Sustainability in Information Systems Research, Decision Support Tools, Design Science, Experimental Economics, Case Study Research, Survey-based Research

Recommended reading

- Watson, R. T., Boudreau, M. C., & Chen, A. J. (2010). Information systems and environmentally sustainable development: energy informatics and new directions for the IS community. MIS quarterly,

23-38.
- Dedrick, J. (2010). Green IS: concepts and issues for information systems research. Communications of the Association for Information Systems, 27(1), 11.
- Seidel, S., Recker, J., & Vom Brocke, J. (2013). Sensemaking and sustainable practicing: functional affordances of information systems in green transformations. MIS quarterly, 1275-1299

Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	every summer term
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	Two exams spread over the semester break	Written or oral exam (depending on participant number)

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture			SuSe	0
Exercises			SuSe	0
Total module attendance time				0 h

inf704 - Computer Science Education III

Module label	Computer Science Education III
Module code	inf704
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Pflichtmodule • Master's Programme Computing Science (Master) > Angewandte Informatik
Responsible persons	• Diethelm, Ira (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	no participant requirements

Skills to be acquired in this module

The students should know research methodical approaches of computer science didactics and be able to apply them exemplarily. They should be able to examine and further develop subject-specific didactic approaches in a well-founded manner and describe the corresponding effects on content, methods and tools of teaching.

Professional competences
The students:

- characterize research methodological approaches in computer science didactics
- investigate an exemplary research question, with the help of research methods of computer science didactics
- differentiate approaches of computer science didactics and their impact on content, methods and tools of teaching

Methodological competences
The students:

- transfer the presented research methods to new questions and adapt them appropriately to develop theories,
- formulate hypotheses for research in the classroom and test them

Social competences
The students:

- discuss in groups the research methods presented
- present research methods they have used and accept criticism or give professional critique

Self-competences
The students:

- incorporate the research methods presented into their actions in order to test their hypotheses
- reflect on their self-image as a researcher in the field of subject didactics

Module contents

The course will address:

- research methodological approaches in computer science didactics
- possibilities of theory-based development of concrete teaching scenarios
- approaches to the evaluation of computer science education and computer science didactics concepts

Recommended reading

- Humbert, Ludger: Didaktik der Informatik. Wiesbaden: B. G. Teubner, 2005.

- Further literature will be announced in the lecture.

Links			
Language of instruction		German	
Duration (semesters)		1 Semester	
Module frequency		jährlich	
Module capacity		unlimited	
Teaching/Learning method		S	
Examination	Prüfungszeiten		Type of examination
Final exam of module			
			Presentation or practical exercises or oral examination

Type of course	Seminar
SWS	2
Frequency	SuSe or WiSe
Workload attendance time	28 h

Informatik, allgemein

inf810 - Special Topics in Computer Science I

Module label	Special Topics in Computer Science I
Module code	inf810
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Computing Science (Master) > Informatik, allgemein • Master's Programme Environmental Modelling (Master) > Mastermodule
Responsible persons	• Peter, Andreas (module responsibility) • Marx Gómez, Jorge (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	The expected previous knowledge is specified in the details of the assigned course.
Skills to be acquired in this module	This module integrates current computer science developments into the business informatics program by appropriate study courses. **Professional competence** The students: • know recent technological or scientific computer science developments • transfer computer science methods and development models to IT application area requirements • evaluate the possibilities and limitations of computer science methods and tools and apply them appropriately **Methodological competence** The students: • review problems, formulate them with formal models and explore them appropriatel • identify and present (one or more) computer science problem solutions • select and evaluate appropriate tools and methods • examine problems with technical and scientific literature **Social competence** The students: • work in a team **Self-competence:** The Students: • plan their informatical actions independently
Module contents	According to the assigned course

Recommended reading	According to the assigned course
Links	
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Reference text	If more than one course is assigned to the module, you should generally select courses totalling 4 SWS, e.g. a lecture with an associated tutorial. Further information can be found in the description (details) of the assigned courses.
Teaching/Learning method	VA from V, Ü, S, P

Examination	Prüfungszeiten	Type of examination
Final exam of module		Portfolio or presentation or oral exam or written exam The concretely chosen form of examination will be announced in the respective assigned courses.

Type of course	Course selection
SWS	4
Frequency	SuSe or WiSe
Workload attendance time	56 h

inf811 - Special Topics in Computer Science II

Module label	Special Topics in Computer Science II
Module code	inf811
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Computing Science (Master) > Informatik, allgemein • Master's Programme Environmental Modelling (Master) > Mastermodule
Responsible persons	• Marx Gómez, Jorge (module responsibility) • Peter, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Useful background knowledge is specified in the details of the assigned course.
Skills to be acquired in this module	This module integrates current computer science developments into the business informatics program, especially considering the selected focus area, by appropriate study courses. **Professional competence** The students: • know recent technological or scientific computer science developments • transfer computer science methods and development models to IT application area requirement • evaluate the possibilities and limitations of computer science methods and tools and apply them appropriately **Methodological competence** The students: • review problems, formulate them with formal models and explore them appropriately • identify and present (one or more) computer science problem solutions • select and evaluate appropriate tools and methods • examine problems with technical and scientific literatur **Social competence** The students: • work in a team **Self-competence:** The Students: • lan their informatical actions independently
Module contents	According to the assigned course
Recommended reading	According to the assigned course
Links	
Language of instruction	German

Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Reference text	If more than one course is assigned to the module, you should generally select courses totalling 4 SWS, e.g. a lecture with an associated tutorial. Further information can be found in the description (details) of the assigned courses.
Teaching/Learning method	2 events from V, Ü, S, P

Examination	Prüfungszeiten	Type of examination
Final exam of module		Portfolio or formal presentation or oral exam or written exam The concretely chosen form of examination will be announced in the respective assigned courses.

Type of course	Course selection
SWS	4
Frequency	SuSe or WiSe
Workload attendance time	28 h

inf812 - Current Topics in Computer Science I

Module label	Current Topics in Computer Science I
Module code	inf812
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Computing Science (Master) > Informatik, allgemein • Master's Programme Environmental Modelling (Master) > Mastermodule
Responsible persons	• Fränzle, Martin Georg (module responsibility) • Marx Gómez, Jorge (module responsibility) • Peter, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Useful background knowledge is specified in the details of the assigned course.
Skills to be acquired in this module	This module integrates current computer science developments into the business informatics program by appropriate study courses. **Professional competence** The students: • know recent technological or scientific computer science developments • transfer computer science methods and development models to IT application area requirements • evaluate the possibilities and limitations of computer science methods and tools and apply them appropriately **Methodological competence** The students • review problems, formulate them with formal models and explore them appropriately • identify and present (one or more) computer science problem solutions • select and evaluate appropriate tools and methods • examine problems with technical and scientific literature **Social competence** The students: • work in a team **Self-competence:** The Students: • plan their informatical actions independently
Module contents	According to the assigned task
Recommended reading	According to the assigned task
Links	

Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	irregular
Module capacity	unlimited
Reference text	If more than one course is assigned to the module, you should generally select a seminar totalling 2 SWS Further information can be found in the description (details) of the assigned courses.
Teaching/Learning method	1 event from V, Ü, S, P, PR

Examination	Prüfungszeiten	Type of examination
Final exam of module		Written exam or portfolio or presentation or oral exam The concretely chosen form of examination will be announced in the respective assigned courses.

Type of course	Course selection
SWS	2
Frequency	--
Workload attendance time	28 h

inf813 - Current Topics in Computer Science II

Module label	Current Topics in Computer Science II
Module code	inf813
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik • Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Computing Science (Master) > Informatik, allgemein • Master's Programme Environmental Modelling (Master) > Mastermodule
Responsible persons	• Marx Gómez, Jorge (module responsibility) • Fränzle, Martin Georg (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	This module integrates current computer science developments into the business informatics program, especially considering the selected focus area, by appropriate study courses. **Professional competence** The students: • know recent technological or scientific computer science developments • transfer computer science methods and development models to IT application area requirements • evaluate the possibilities and limitations of computer science methods and tools and apply them appropriately **Methodological competenc** The students: • review problems, formulate them with formal models and explore them appropriately • Identify and present (one or more) computer science problem solutions • select and evaluate appropriate tools and methods • examine problems with technical and scientific literature **Social competence** The students: • work in a team **Self-competence:** The Students: • plan their informatical actions independently
Module contents	According to the assigned task
Recommended reading	According to the assigned task
Links	
Language of instruction	German
Duration (semesters)	1 Semester

Module frequency	every semester
Module capacity	unlimited
Reference text	If more than one course is assigned to the module, you should generally select a seminar totalling 2 SWS Further information can be found in the description (details) of the assigned courses.
Teaching/Learning method	1 event of V, Ü, S, P, PR

Examination	Prüfungszeiten	Type of examination
Final exam of module		Exercises or presentation or oral exam or written exam

Type of course	Course selection
SWS	2
Frequency	--
Workload attendance time	28 h

inf814 - Aktuelle Themen aus dem Gebiet "Safety-Security-Interaction" I

Module label	Aktuelle Themen aus dem Gebiet "Safety-Security-Interaction" I
Module code	inf814
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Computing Science (Master) > Informatik, allgemein
Responsible persons	• Peter, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Useful background knowledge is specified in the details of the assigned course.
Skills to be acquired in this module	This module integrates current computer science developments into the computer science Master program, especially considering the selected Master specialization, by appropriate study courses **Professional competence** The students: • know recent technological or scientific computer science developments • transfer computer science methods and development models to IT application area requirements • evaluate the possibilities and limitations of computer science methods and tools and apply them appropriately **Methodological competenc** The students: • analyze the technical merits of specific developments within the field of "Safety-Security-Interaction" • substantiate their analyses using existing and scientific documented knowledge • clearly write up those analyses in a concise scientific report • present their results in a scientific talk **Social competence** The students: • communicate persuasively orally and in writing • further develop an attitude in which being able to clearly explain matters is geared to optimize the quality of feedback **Self-competence** The students: • critically follow further developments in computer science in general and in their special field • develop and reflect on their own theories in relation to independently formulated hypotheses
Module contents	According to the assigned course/task
Recommended reading	Will be announced in the course
Links	
Language of instruction	English

Duration (semesters)	1 Semester	
Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	V or S	

Examination	Prüfungszeiten	Type of examination
Final exam of module		
		Portfolio or Presentation or oral exam or written exam The concretely chosen form of examination will be announced in the respective assigned courses.

Type of course	Seminar
SWS	0
Frequency	see frequency of module offering

inf815 - Aktuelle Themen aus dem Gebiet "Safety-Security-Interaction" II

Module label	Aktuelle Themen aus dem Gebiet "Safety-Security-Interaction" II
Module code	inf815
Credit points	3.0 KP
Workload	90 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Computing Science (Master) > Informatik, allgemein
Responsible persons	• Peter, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Useful background knowledge is specified in the details of the assigned course.
Skills to be acquired in this module	This module integrates current computer science developments into the computer science Master program, especially considering the selected Master specialization, by appropriate study courses **Professional competence** The students: • know recent technological or scientific computer science developments • transfer computer science methods and development models to IT application area requirements • evaluate the possibilities and limitations of computer science methods and tools and apply them appropriately **Methodological competenc** The students: • analyze the technical merits of specific developments within the field of "Safety-Security-Interaction" • substantiate their analyses using existing and scientific documented knowledge • clearly write up those analyses in a concise scientific report • present their results in a scientific talk **Social competence** The students: • communicate persuasively orally and in writing • further develop an attitude in which being able to clearly explain matters is geared to optimize the quality of feedback **Self-competence** The students: • critically follow further developments in computer science in general and in their special field • develop and reflect on their own theories in relation to independently formulated hypotheses
Module contents	According to the assigned course/task
Recommended reading	Will be announced in the course
Links	
Language of instruction	English

Duration (semesters)	1 Semester	
Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	V or S	

Examination	Prüfungszeiten	Type of examination
Final exam of module		
		Portfolio or Presentation or oral exam or written exam The concretely chosen form of examination will be announced in the respective assigned courses.

Type of course	Seminar
SWS	0
Frequency	see frequency of module offering

inf862 - Study Abroad I

Module label	Study Abroad I
Module code	inf862
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Informatik, allgemein • Master's Programme Computing Science (Master) > Interdisziplinäre Module
Responsible persons	• Vogel-Sonnenschein, Ute (module responsibility) • Boll-Westermann, Susanne (Module counselling) • Marx Gómez, Jorge (Module counselling) • Fränzle, Martin Georg (Module counselling) • Peter, Andreas (Module counselling)
Further responsible persons	Program directors of the Master's degree programs in Computer Science and Business Informatics
Prerequisites	According to the requirements of the selected courses at the international host university
Skills to be acquired in this module	**Professional competence** • depending on the chosen course at the host university **Methodological competence** • depending on the chosen course at the host university The students • organize themselves independently in the culture of the host country • use time and other resources efficiently and in a goal-oriented manner **Social competence** The students • have intercultural competence: they interact successfully and appropriately with individuals and groups from other cultures, • communicate with people from other cultures in a targeted and respectful manner, • have in-depth empathic skills. They empathize with other people on a cognitive and emotional level, listen carefully and attentively, and understand the opinions of others. **Self-competence** The students • have generally deepened their skills in a foreign language for subject-related discourse, • express themselves fluently in the language of their host country, • adapt to changing living and learning environments, • deal tolerantly with ambiguities, • approach other people openly, • assess their own strengths and weaknesses appropriately, • make appropriate decisions even in difficult situations, • work on challenges in a solution- and goal-oriented manner, • face up to new tasks, challenges and experiences.
Module contents	The ongoing process of globalization requires preparation for professional for professional activities that are increasingly internationally oriented. This requires not only foreign language skills, but also intercultural skills in

particular.
These skills are intensively promoted during a semester abroad.
As courses at the host university can also relate to areas of knowledge that are not included in the Computer Science curriculum or are outside of Computer Science, such coursework completed in the host country can be credited via this module.
The choice of courses at the host university is agreed in advance of the stay as part of a learning agreement with the student advisor or, depending on the requirements of the place of study and the study financing, with the international representatives of the Department of Computer Science.

Recommended reading

Specification of the foreign university

Links

- International Student Office of CvO Universität
- Web-Site of the Computer Science Department (in German)

Languages of instruction	English , French, German
Duration (semesters)	1 Semester
Module frequency	individual
Module capacity	unlimited
Teaching/Learning method	Requirement of the foreign university

Examination	Prüfungszeiten	Type of examination
Final exam of module		Specification of the foreign university Recognition must be applied for at the Academic Examinations Office. Transcripts of records from courses attended at the foreign university must be submitted in German or English translation.

Type of course	Course selection
SWS	0
Frequency	--
Workload attendance time	56 h

inf863 - Study Abroad II

Module label	Study Abroad II
Module code	inf863
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Informatik, allgemein • Master's Programme Computing Science (Master) > Interdisziplinäre Module
Responsible persons	• Vogel-Sonnenschein, Ute (module responsibility) • Fränzle, Martin Georg (Module counselling) • Marx Gómez, Jorge (Module counselling) • Peter, Andreas (Module counselling) • Boll-Westermann, Susanne (Module counselling)
Further responsible persons	Studiengangsverantwortliche der Master-Studiengänge Informatik und Wirtschaftsinformatik
Prerequisites	According to the requirements of the selected courses at the international host university
Skills to be acquired in this module	**Professional competence** • depending on the chosen course at the host university **Methodological competence** • depending on the chosen course at the host university The students • organize themselves independently in the culture of the host country • use time and other resources efficiently and in a goal-oriented manner **Social competence** The students • have intercultural competence: they interact successfully and appropriately with individuals and groups from other cultures, • communicate with people from other cultures in a targeted and respectful manner, • have in-depth empathic skills. They empathize with other people on a cognitive and emotional level, listen carefully and attentively, and understand the opinions of others. **Self-competence** The students • have generally deepened their skills in a foreign language for subject-related discourse, • express themselves fluently in the language of their host country, • adapt to changing living and learning environments, • deal tolerantly with ambiguities, • approach other people openly, • assess their own strengths and weaknesses appropriately, • make appropriate decisions even in difficult situations, • work on challenges in a solution- and goal-oriented manner, • face up to new tasks, challenges and experiences.
Module contents	The ongoing process of globalization requires preparation for professional for professional activities that are increasingly internationally oriented. This requires not only foreign language skills, but also intercultural skills in

particular.
These skills are intensively promoted during a semester abroad.
As courses at the host university can also relate to areas of knowledge that are not included in the Computer Science curriculum or are outside of Computer Science, such coursework completed in the host country can be credited via this module.
The choice of courses at the host university is agreed in advance of the stay as part of a learning agreement with the student advisor or, depending on the requirements of the place of study and the study financing, with the international representatives of the Department of Computer Science.

Recommended reading

Specification of the foreign university

Links

- International Student Office of CvO Universität
- Web-Site of the Computer Science Department (in German)

Languages of instruction	English , French, German
Duration (semesters)	1 Semester
Module frequency	individual
Module capacity	unlimited
Teaching/Learning method	Requirement of the foreign university

Examination	Prüfungszeiten	Type of examination
Final exam of module		Specification of the foreign university Recognition must be applied for at the Academic Examinations Office. Transcripts of records from courses attended at the foreign university must be submitted in German or English translation.

Type of course	Course selection
SWS	0
Frequency	--
Workload attendance time	56 h

Interdisziplinäre Module

inf207 - Electrical Engineering

Module label	Electrical Engineering
Module code	inf207
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik • Dual-Subject Bachelor's Programme Computing Science (Bachelor) > Wahlpflicht Technische Informatik (30 KP) • Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Technische Informatik) • Master of Education Programme (Hauptschule and Realschule) Computing Science (Master of Education) > Mastermodule • Master's Programme Computing Science (Master) > Interdisziplinäre Module
Responsible persons	• Hein, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Module Analysis II or Numerics
Skills to be acquired in this module	Professional competence: The students: • analyse linear electrical networks (direct current and alternating current) • name basic concepts to calculate and to use electrical and magnetic fields • list the characteristics of simple electrical elements (two terminal networks) • calculate the parameters of simple electrical networks/wirings • apply computer based analysing tools • design and implement simple networks/wirings **Methodological competence:** The students: • transfer calculation methods onto complex dynamic systems • implement electrical system models **Social competence:** The students: • present solutions for specific questions **Self-competence:** The students: • reflect their solutions by using methods learned in this course
Module contents	• Basic concepts (electric dimensions and units) • Network elements • Calculation of linear direct current networks (Ohms law, Kirchhoff's circuit law, superposition principle) • Characteristics, calculations and representations of electric and magnetic fields • Construction elements (capacitor and coil) • Extensions of periodical dimensions dependent on time, pointer representation, calculations with complex root-mean-square value pointers

Recommended reading

essential:

- slides
- Albach: Grundlagen der Elektrotechnik 1 und 2. Pearson Studium, 2004.

recommended:

- Hagmann, G.: Grundlagen der Elektrotechnik. AULA-Verlag, 2002.
- Hagmann, G.: Aufgabensammlung zu den Grundlagen der Elektrotechnik. AULA-Verlag, 2002.

Links	
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the End of the Semester	Hands-on exercises / written exam or oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		3	SuSe	42
Exercises		1	SuSe	14
Total module attendance time				56 h

inf208 - Microrobotics and Microsystems Technology

Module label	Microrobotics and Microsystems Technology
Module code	inf208
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik • Dual-Subject Bachelor's Programme Computing Science (Bachelor) > Wahlpflicht Technische Informatik (30 KP) • Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Technische Informatik) • Master's Programme Computing Science (Master) > Interdisziplinäre Module
Responsible persons	• Fatikow, Sergej (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	Within the last few years, microrobotics and microsystem technology (MST) have become a focus of interest to industry and evolved into an important field with great application potential. It plays a decisive role for industry to be competitive in many areas such as medicine, production engineering, biotechnology, environmental technology, automotive products, etc. Despite of the growing interest in this new technology, there is hardly any book or lecture course that treats microrobotics and MST in a coherent and comprehensive way. This course is an attempt of the Microrobotics and Control Engineering Division (AMiR) to give students a systematic introduction to microrobotics and MST. It discusses all important aspects of this rapidly expanding technology, its diversity of products and fields of application. The course contains an overview of numerous ideas of new devices and the problems of manufacturing them. **Professional competence:** The students: • name the ideas, challenges and activities of microrobotics and microsystem technology • describe the microrobotics and MST applications • characterise MST methods • name microsensor functionality • characterise microsensor examples • discuss MST terms of information technology • classify microrobotics **Methodological competence** The students: • discover interdisciplinary connections and links between scientific and technical fields of research and development • learn technical abstraction of complex contexts **Social competence** The students: • solving problems partially as group • present their solutions and approaches to the group **Self-competence** The students: • reflect their knowledge of technical computer science • learn to expand on their professional competence independently
Module contents	Ideas and problems of microrobotics and MST: • applications;

- techniques of MST;
- silicon-based micromechanics;
- LIGA technology;

Microactuators:

- principles and examples (electrostatic, piezoelectric, magnetostrictive, electromagnetic, SMA-based, thermomechanical, electrorheological and other actuators);

Microsensors:

- principles and examples (force and pressure, position and speed, acceleration, biological and chemical, temperature and other sensors);
- MST and information processing;
- microsystem design and simulation;
- classification of microrobots;
- coarse positioning of a microrobot;
- fine positioning of a microrobot;

Handling of microparts:

- problems and solutions;
- micro grasp techniques;
- microassembly;

Process automation by microrobots:

- desktop robot cell in SEM

Recommended reading

Essential:

- Vorlesungsskript in Buchform

Recommended:

- Fatikow, S.: Mikroroboter und Mikromontage, Teubner, Stuttgart Leipzig, 2000
- Fatikow, S./Rembold, U.: Microsystem Technology and Microrobotics, Springer, Berlin Heidelberg New York, 1997
- Menz, W. und Mohr, J.: Mikrosystemtechnik für Ingenieure, VCH, Weinheim, 1997

Secondary Literature:

- Brück, A. und Schmidt, A.: Angewandte Mikrotechnik, Hanser, München Wien, 2001
- Ehrfeld, W. (Hrsg.): Handbuch Mikrotechnik, Hanser, München Wien, 2000
- Elbel, Th.: Mikrosensorik, Vieweg, Wiesbaden, 1996
- Fukuda, T. and Menz, W. (Eds.): Micro Mechanical Systems, Elsevier, Amsterdam, 1998
- Gardner, J.W.: Microsensors, Wiley, Chichester, 1994
- Gerlach, G. und Dötzel, W.: Grundlagen der Mikrosystemtechnik, Hanser, München Wien, 1997
- Krause, W.: Fertigung in der Feinwerk- und Mikrotechnik, Hanser, 1995
- Mescheder, U.: Mikrosystemtechnik, Teubner, Stuttgart Leipzig, 2000
- Tränkler, H.-R. und Obermeier, E. (Hrsg.): Sensortechnik, Springer, Berlin Heidelberg, 1998
- Völklein, F. und Zetterer, Th.: Einführung in die Mikrosystemtechnik, Vieweg, Wiesbaden, 2000

Links	
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Reference text	

Associated with the modules:

- Embedded Systems and Microrobotics

Teaching/Learning method	V+Ü	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the semester	Oral exam in German

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		3	WiSe	42
Exercises		1	WiSe	14
Total module attendance time				56 h

inf209 - Control Theory

Module label	Control Theory
Module code	inf209
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik • Dual-Subject Bachelor's Programme Computing Science (Bachelor) > Wahlpflicht Technische Informatik (30 KP) • Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Technische Informatik) • Master's Programme Computing Science (Master) > Interdisziplinäre Module
Responsible persons	• Fatikow, Sergej (module responsibility) • Hein, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	• Differential Equations • Analysis II • Fundamentals of electrical engineering
Skills to be acquired in this module	Instruction on theoretical and mathematical basics of control engineering **Professional competence** The students: • describe the core principles of steering and control of technical systems • discuss the modelling core concepts of systems and their controllers • name methods to determine the quality of controlled systems • model technical systems with differential equations and their transfer functions • develop control structures, evaluate their stabilty and determine their optimal control parameters **Methodological competence** The students: • are aware of the technical challenges and solve them by including the implementations of other disciplines and methods **Social competence** The students: • present solutions for specific questions **Self-competence** The students: • get used to the specific challenges of the development of controlled systems
Module contents	Basics analog transfer elements: • linear time invariant (LTI-) systems; • simulation and modeling; • step response; • frequency response; • frequency response locus; • differential equations and transfer function; control loop stability; • types of controlled systems; • types of linear controllers; **linear control loops:**

- reference and disturbance reaction of the controlled system;
- rules for control loop optimization;
- methods of analysis and synthesis, implementation;
- computerbased control MATLAB/Simulink

Recommended reading

- Unbehauen, H.:Regelungstechnik I, Klassische Verfahren zur Analyse und Synthese linearer kontinuierlicher Regelsysteme
- Lutz, H. und Wendt, W.:Taschenbuch der Regelungstechnik
- further reading will be announced at lecture

Links		
Language of instruction	German	
Duration (semesters)	1 Semester	
Module frequency	annual	
Module capacity	unlimited	
Teaching/Learning method	V+Ü	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Hands-on exercises and written or oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		3	WiSe	42
Exercises		1	WiSe	14
Total module attendance time				56 h

inf210 - Signal and Image Processing

Module label	Signal and Image Processing
Module code	inf210
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik • Dual-Subject Bachelor's Programme Computing Science (Bachelor) > Wahlpflicht Technische Informatik (30 KP) • Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Technische Informatik) • Master's Programme Computing Science (Master) > Interdisziplinäre Module
Responsible persons	• Hein, Andreas (module responsibility) • Fränzle, Martin Georg (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Module math040 Analysis II b: Differential calculus of several variables
Skills to be acquired in this module	Professional competence The students: • name the concepts of signal and image processing in technical systems • name the methods/algorithms of preprocessing, filtering, classification, interpretation and visualisation of signals and pictures • Select algorithms appropriately • evaluate the effectiveness of algorithms • design algorithms and processing chains and evaluate their quality **Methodological competence** The students: • get used to specific subjects of signal and image processing **Social competence** The students: • present solutions for specific questions in signal and image processing **Self-competence** The students: • reflect their solutions by using methods learned in this course
Module contents	Basic Concepts: • Signal Processing • Signal Spaces and Signal Processing Systems • Discrete and Constant Signals • Labelling of Signal Transmitters with Test Signals • Representations Areas and Transformations • Time-Discrete Systems and Scanning • Estimation and Filtering • Construction with MATLAB • Image Processing **Introduction / Range of Applications:** • Functional Transformation • Image Enhancement/Filtering • Segmentation • 3D Reconstruction an Visualization

Recommended reading	Essential: • Foliensammlung zur Vorlesung **Recommended:** • Meyer, M.; Signalverarbeitung: Analoge und digitale Signale, Systeme und Filter • Grüningen, D. C. v.; Digitale Signalverarbeitung: mit einer Einführung in die kontinuierlichen Signale und Systeme • Tönnies, K.; Grundlagen der Bildverarbeitung; Pearson Studium 2005 • Lehmann, Th.; Oberschelp, W.; Pelinak, E.; Pepges, R.; Bildverarbeitung in der Medizin; Springer Verlag 1997 • Handels. H.; Medizinische Bildverarbeitung; Teubner Verlag, Stuttgart • Leipzig 2000 weiterführende Literatur wird in der Vorlesung bekannt gegeben

Links	
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module	At the end of the semester	Hands-on exercises and written or oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	WiSe	28
Exercises		2	WiSe	28
Total module attendance time				56 h

inf305 - Medical Technology

Module label	Medical Technology
Module code	inf305
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Interdisziplinäre Module • Master's Programme Computing Science (Master) > Technische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Hein, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	useful knowledge in - Signal and Image Processing - Control Engineering
Skills to be acquired in this module	Professional competence The students: • Describe medical diagnosis and therapy methods • Understand the core concepts of computer-assisted medical interventions • Are aware of the basic concepts and legal conditions of the development of medical devices • Define the character of medical devices' software parts and implement them • Assess the complex interaction of medical products and patients • Get familiar with the development of medical products within a short period of time **Methodological competence** The students: • Recognise the interdisciplinary challenges and accordingly exchange information with other disciplines **Social competence** The students: • Present solutions for specific questions **Self-competence** The students: • reflect their solutions by using methods learned in this course
Module contents	• Medical areas and areas of application • Basic requirements for medical systems (hygiene, MPG, technical security, materials) Medical systems: • Functional diagnostics (ECG, EMG, EEG) • Imaging systems (CT, MRI, ultrasound, PET, SPECT) • Therapy equipment (Laser, RF, Microtherapy) • Signal processing / monitoring (cardiovascular, hemodynamic, respiratory, metabolic, cerebral) • Medical Informatics (HIS, DICOM, Telemedicine, VR, image

processing).

Recommended reading	essential: • Kramme, R.: Medizintechnik. Verfahren, Systeme und Informationssysteme. Springer Verlag, 2002 (2. Auflage) • Lecture slides • recommended: • Lehmann, Th.; Oberschelp, W.; Pelikan, E.; Pepges, R.: Bildverarbeitung in der Medizin. Springer Verlag, 1997 • Dugas, M.; Schmidt, K.: Medizinische Informatik und Bioinformatik. Springer Verlag, 2003 **secondary literature:** • Taylor, R.H. et al.: Computer-Integrated Surgery. Technology and clinical Applikations. MIT Press, Cambridge, MA, 1996
Links	
Languages of instruction	English , German
Duration (semesters)	1 Semester
Module frequency	once a year
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture periode	Portfolio

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		3	WiSe	42
Exercises		1	WiSe	14
Total module attendance time				56 h

inf307 - Robotics

Module label	Robotics
Module code	inf307
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Interdisziplinäre Module • Master's Programme Computing Science (Master) > Technische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Hein, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No participant requirements
Skills to be acquired in this module	Professional competence The students: • Name and know the functions and applications of robot systems • Characterise the basic concepts to program robot systems • Differentiate between the interaction of mechanical, electrical and software components **Methodological competence** The students: • Define characteristics and components of robot systems for a specific application • Design and implement robot system sub-components • Design and parameterise simple control structures • Plan the application of robot systems and derive the requirements • Model electrical and mechanical systems • Develop and realise simple robot systems **Social competence** The students: • Solve robot systems problems in team work **Self-competence** The students: • Reflect their solutions in reference to robot system methods
Module contents	Integration in production plants / aims / subsystems • Architectures / classifications (classification of robots) • Robot components + Computer systems for programming -- PA-10 -- Lego Mindstorms • Basics of kinematics -- Coordinate transformation, homogeneous coordinates, Coordinate transitions -- Kinematic equation systems, transformation of vectors • Kinematic -- Joint types (manipulators) / Wheels, TCP -- Denavit-Hartenberg-Transformation -- Forward calculation -- Backward calculation • Sensors -- General properties of sensors, parameter -- Simple optical position sensors -- Inductive-, capacitive- und ultrasonic-sensors -- Distance sensors (laser scanner, triangulation sensors) -- Force sensors -- Sensor data preparation

- Planing / Regulation -- Overall regulation approach, terms, process- and control functions, PID-controller -- Planning concepts and approaches (On-Line, Off-Line), planning processes, construction and path planning - Actuators

Recommended reading	essential: • lecture nodes **recommended:** • Lüth, T.: Technische Multi-Agenten-Syteme. Hanser-Verlag, 1998. • Siegert, H.-J.; Bocionek, S.: Programmierung intelligenter Roboter. Springer Verlag, 1996. • Craig, J.J.: Introduction to Robotics: Mechanics and Control. Prentice Hall, 1989. • Juckenack, D.: Handbuch der Sensortechnik: Messen mechanischer Größen. Verlag moderne Industrie, Landsberg/Lech, 1989. • Jiang, X.; Bunke, H.: Dreidimensionales Computersehen (Gewinnung und Analyse von Tiefenbildern), Springer Verlag, 1997. **sekondary literature:** • Hommel, G.; Heiß, H.: Roboterkinematik. Bericht 1990-15 an der TU-Berlin. Muir, P.F.; Neuman, C.P.: Kinematic Modeling of Wheeled Mobile Robots. Journal of Robotic Sytemes, 4(2) 281-340, 1987.
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture periode	Portfolio: Hands-on exercises, report, and written or oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		3	SuSe	42
Exercises		1	SuSe	14
Total module attendance time				56 h

inf308 - Microrobotics II

Module label	Microrobotics II
Module code	inf308
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Interdisziplinäre Module • Master's Programme Computing Science (Master) > Technische Informatik • Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction • Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
Responsible persons	• Fatikow, Sergej (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Participation in Microrobotics and Microsystems Engineering would be helpful
Skills to be acquired in this module	After having given an established introduction in the module “Microrobotics and Microsystem Technology” this lecture offers a further specialisation in microrobotics. Within the course, all relevant areas (among others the research topics of the division “Microrobotics and Control Engineering (AMiR)”) will be presented and analysed. The student will be provided with an insight into current research projects of AMiR and of other research institutes of microrobotics worldwide; here mainly the requirements of industry to microrobots will be discussed. The lecture will be enhanced by practical courses in the research laboratories of AMiR. **Professional competence** The students: • name and recognise the basic concepts of nanotechnology, in particular, micro- and nanorobotics approaches • differentiate the development, control and application of micro- and nanorobotics systems - implement and design application-specific mirco- and nanorobotics systems **Methodological competence** The students: • transfer their control engineering and image processing abilities on interdisciplinary problems • transfer their hands-on experience to develop controls and apllications of microrobotic systems on new tasks **Social competence** The students: • work in a team **Self-competence** The students: • reflect their problem-solving behaviour and use hands-on experience to develop, control and application of microrobotics
Module contents	• Smart and versatile microrobots; microactuators (piezo-, ferrofluid- and SMA-actuators) for microrobots; • real-time image processing in the micro world (SEM, optical microscopy); • micro force sensors and tactile sensors for microrobots; • microrobot control systems, e.g. neural networks and fuzzy logic; • haptic interface for the control of microrobots;

- neural speech interface for the control of microrobots;
- robot-based micro- and nanohandling (SEM, optical microscopy);
- applications: microassembly, nano-testing, cell handling;
- Micro Air Vehicles (MAVs); multi-robot systems: team behavior, communication, control issues

Recommended reading

- Lecture notes (can be obtained in secretariate, A1-3-303)
- Fatikow, Sergej (Ed.): Automated Nanohandling by Microrobots, Springer, London, 2008

Links	
Languages of instruction	English , German
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module	After the end of the module until the beginning of the next lecture period	Oral Exam and exercises

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		3	SuSe	42
Exercises		1	SuSe	14
Total module attendance time				56 h

inf524 - Medical Basics

Module label	Medical Basics
Module code	inf524
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Angewandte Informatik • Master's Programme Computing Science (Master) > Interdisziplinäre Module
Responsible persons	• Wulff, Antje (module responsibility) • Klausen, Andreas (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	No specific prior knowledge is required

Skills to be acquired in this module

The aim of the modul is to provide students with a basic knowledge of humand medicine. This should facilitate the understanding of the domain in case of a career choice or focus on medical informatics / medical technology and lead to basics for own questions and ideas for the application of methods of informatics in medicine.

Professional competence
The students

- learn the basics of medical terminology (Terminologia Anatomica) and the anatomy of the human body and can name the most important structure in technical language
- Know the basics of the physiology of the human body and can descriube the essential body functions
- Gain insights into pathophysiological processes of the human body and the associated effects on the function of the human organism
- Know the control circuits of the human body for maintaining important body unctions and know that this control circuits can be used as a possibility to intervene in processes of the human body
- Know reference values of important physiological paremeters and can derive conclusions on body functions

Methodological competence
The students

- know the possible measurement procedures resulting from the physiological processes of the human body.
- pply measurement procedures to describe and evaluate human body functions. They can name examples of use and examples of interpretation
- know influencing variables that affect the interpretation of results from measurement procedures as well as the limits of measurement procedures
- learn how to carry out examinations according to protocols and how to document the results in a standardized way.

Social competence
The students

- experience an appreciative interaction with each other through regular role changes
- they take on the role of the test person as well as that of the experimenter
- an appreciative way of dealing with each other.
- describe in detail the data obtained in measurement procedures and consider them critically with other students
- integrate professional and factual criticism into their own courses of action
- use simulated examples from everyday clinical practice to learn the standardized procedures necessary to ensure patient safety

Self competence
The students

- deal with the function, the efficiency of the own body but also with its limits
  deal with the life cycle of conception, birth, adolescence, adulthood and aging

Module contents	See assigned course description
Recommended reading	As announced in course
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	every summer term
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Written exam or oral exam The chosen form of examination will be announced in the first week of the course

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	28
Exercises		2	SuSe	28
Total module attendance time				56 h

inf951 - Interdisciplinary Module II

Module label	Interdisciplinary Module II
Module code	inf951
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Interdisziplinäre Module
Responsible persons	• Vogel-Sonnenschein, Ute (module responsibility) • Vogel-Sonnenschein, Ute (Module counselling) • Lehrenden, Die im Modul (authorised to take exams)
Further responsible persons	Studiengangsverantwortliche der Master-Studiengänge Informatik und Wirtschaftsinformatik
Prerequisites	Depending on the allocated course
Skills to be acquired in this module	The graduates know the basics and the application-relevant application-relevant background of the selected discipline. **Professional competencies** The students: • identify the fundamentals and methods of the chosen field • use the technical language of the field of application competently **Methodological competencies** The students: • characterize the context of use and requirements of IT in the chosen field • apply the disciplinary methods and techniques of the application area and contrast them with the methods and techniques • known from methods and techniques • known from computer science • investigate problems of an application area with the methods and techniques typical for the discipline methods **Social competencies** The students: • can appreciate the diversity of subject cultures and • respect other disciplines and their way of working • prepare themselves for application scenarios for IT systems **Self-competences** The students: • reflect on their self-image and actions against the background of a other subject discipline
Module contents	The module is instantiated with modules from other disciplines or modules from the Department of Computer Science, which provide an interdisciplinary insight into another scientific discipline. The types of courses and examination modalities depend on the module selected.
Recommended reading	
Links	
Languages of instruction	English , German
Duration (semesters)	1 Semester
Module frequency	irregular

Module capacity	unlimited	
Teaching/Learning method	events from V, S, Ü, P	

Examination	Prüfungszeiten	Type of examination
Final exam of module		
		Portfolio or presentation or oral examination or written examination.

Type of course	Course selection
SWS	4
Frequency	--
Workload attendance time	56 h

inf862 - Study Abroad I

Module label	Study Abroad I
Module code	inf862
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Informatik, allgemein • Master's Programme Computing Science (Master) > Interdisziplinäre Module
Responsible persons	• Vogel-Sonnenschein, Ute (module responsibility) • Boll-Westermann, Susanne (Module counselling) • Marx Gómez, Jorge (Module counselling) • Fränzle, Martin Georg (Module counselling) • Peter, Andreas (Module counselling)
Further responsible persons	Program directors of the Master's degree programs in Computer Science and Business Informatics
Prerequisites	According to the requirements of the selected courses at the international host university
Skills to be acquired in this module	**Professional competence** • depending on the chosen course at the host university **Methodological competence** • depending on the chosen course at the host university The students • organize themselves independently in the culture of the host country • use time and other resources efficiently and in a goal-oriented manner **Social competence** The students • have intercultural competence: they interact successfully and appropriately with individuals and groups from other cultures, • communicate with people from other cultures in a targeted and respectful manner, • have in-depth empathic skills. They empathize with other people on a cognitive and emotional level, listen carefully and attentively, and understand the opinions of others. **Self-competence** The students • have generally deepened their skills in a foreign language for subject-related discourse, • express themselves fluently in the language of their host country, • adapt to changing living and learning environments, • deal tolerantly with ambiguities, • approach other people openly, • assess their own strengths and weaknesses appropriately, • make appropriate decisions even in difficult situations, • work on challenges in a solution- and goal-oriented manner, • face up to new tasks, challenges and experiences.
Module contents	The ongoing process of globalization requires preparation for professional for professional activities that are increasingly internationally oriented. This requires not only foreign language skills, but also intercultural skills in

particular.
These skills are intensively promoted during a semester abroad.
As courses at the host university can also relate to areas of knowledge that are not included in the Computer Science curriculum or are outside of Computer Science, such coursework completed in the host country can be credited via this module.
The choice of courses at the host university is agreed in advance of the stay as part of a learning agreement with the student advisor or, depending on the requirements of the place of study and the study financing, with the international representatives of the Department of Computer Science.

Recommended reading

Specification of the foreign university

Links

- International Student Office of CvO Universität
- Web-Site of the Computer Science Department (in German)

Languages of instruction	English , French, German
Duration (semesters)	1 Semester
Module frequency	individual
Module capacity	unlimited
Teaching/Learning method	Requirement of the foreign university

Examination	Prüfungszeiten	Type of examination
Final exam of module		Specification of the foreign university Recognition must be applied for at the Academic Examinations Office. Transcripts of records from courses attended at the foreign university must be submitted in German or English translation.

Type of course	Course selection
SWS	0
Frequency	--
Workload attendance time	56 h

inf852 - IT Project Management

Module label	IT Project Management
Module code	inf852
Credit points	6.0 KP
Workload	180 h

Applicability of the module

- Bachelor's Programme Biology (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Business Administration and Law (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Business Informatics (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Chemistry (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Comparative and European Law (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel more...
- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik
- Bachelor's Programme Computing Science (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Economics and Business Administration (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Economics and Business Administration (Bachelor) > Studienrichtung Wirtschaftsinformatik
- Bachelor's Programme Education (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Engineering Physics (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Environmental Science (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Intercultural Education and Counselling (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Mathematics (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Physics (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Physics, Engineering and Medicine (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Social Studies (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Sustainability Economics (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Art and Media (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Biology (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Chemistry (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Computing Science (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Dutch Linguistics and Literary Studies (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Economic Education (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Economics and Business Administration (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Education (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Elementary Mathematics (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme English Studies (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Gender Studies (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme General Education (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme German Studies (Bachelor) >

Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme History (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-subject bachelor's programme Low German (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Material Culture: Textiles (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Mathematics (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Music (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Philosophy / Values and Norms (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Physics (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Politics-Economics (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Protestant Theology and Religious Education (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Slavic Studies (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Social Studies (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Special Needs Education (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Sport Science (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Technology (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Fach-Bachelor Pädagogisches Handeln in der Migrationsgesellschaft (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Master's Programme Computing Science (Master) > Interdisziplinäre Module

Responsible persons

- Sauer, Jürgen (authorised to take exams)
- Lehrenden, Die im Modul (authorised to take exams)

Prerequisites

No participant requirements

Skills to be acquired in this module

The participants of this course are aware of problems, activities and tools of data processing project management (DP-Project-Management). They are able to identify and select the corresponding tools in different project stages and are familiar with those tools. They are able to describe the business informatics fields of actions. The are competent to work in a team and organise and implement projects.

Professional competence

The students:

- characterise problems, activities and tools of the data processing project management.
- are able to identify the corresponding tools in different project stages
- use specific DP-Project-Management tools
- differentiate the business informatics field of actions

Methodological competence

The students:

- perform projects with the tools of each phase

Social competence

The students:

- work in small project-teams
- make design decisions cooperatively
- present solutions

Self-competence

The students:

- acquire DP-Project-Management methods and use them
- recognise and are responsible for working packages

Module contents	It is important to know different IT project management types and forms as well as corresponding methods and tools. This course provides basic data-processing problems, activities and methods. The course is based on M. Burghardt's book. **After an introduction, the course is divided as follows:** • Project management (Requirements Engineering, Profitability Analysis, Organisational Structure) • Project Planning (Project Structure, Network Analysis, Project Plans) • Project Control (Cost Evaluation, Quality Control) • Project Completion The participants get familiar with project management tools. • Presentations drawn from practice are intended.
Recommended reading	• Burghardt, M.(2006): Projektmanagement, 7.Auflage, Publicis Corporate Publishing.
Links	
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	annual
Module capacity	unlimited
Teaching/Learning method	V+Ü

Examination	Prüfungszeiten	Type of examination
Final exam of module		
	At the end of the lecture period	Written or oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	28
Exercises		2	SuSe	28
Total module attendance time				56 h

inf863 - Study Abroad II

Module label	Study Abroad II
Module code	inf863
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Informatik, allgemein • Master's Programme Computing Science (Master) > Interdisziplinäre Module
Responsible persons	• Vogel-Sonnenschein, Ute (module responsibility) • Fränzle, Martin Georg (Module counselling) • Marx Gómez, Jorge (Module counselling) • Peter, Andreas (Module counselling) • Boll-Westermann, Susanne (Module counselling)
Further responsible persons	Studiengangsverantwortliche der Master-Studiengänge Informatik und Wirtschaftsinformatik
Prerequisites	According to the requirements of the selected courses at the international host university
Skills to be acquired in this module	**Professional competence** • depending on the chosen course at the host university **Methodological competence** • depending on the chosen course at the host university The students • organize themselves independently in the culture of the host country • use time and other resources efficiently and in a goal-oriented manner **Social competence** The students • have intercultural competence: they interact successfully and appropriately with individuals and groups from other cultures, • communicate with people from other cultures in a targeted and respectful manner, • have in-depth empathic skills. They empathize with other people on a cognitive and emotional level, listen carefully and attentively, and understand the opinions of others. **Self-competence** The students • have generally deepened their skills in a foreign language for subject-related discourse, • express themselves fluently in the language of their host country, • adapt to changing living and learning environments, • deal tolerantly with ambiguities, • approach other people openly, • assess their own strengths and weaknesses appropriately, • make appropriate decisions even in difficult situations, • work on challenges in a solution- and goal-oriented manner, • face up to new tasks, challenges and experiences.
Module contents	The ongoing process of globalization requires preparation for professional for professional activities that are increasingly internationally oriented. This requires not only foreign language skills, but also intercultural skills in

	particular. These skills are intensively promoted during a semester abroad. As courses at the host university can also relate to areas of knowledge that are not included in the Computer Science curriculum or are outside of Computer Science, such coursework completed in the host country can be credited via this module. The choice of courses at the host university is agreed in advance of the stay as part of a learning agreement with the student advisor or, depending on the requirements of the place of study and the study financing, with the international representatives of the Department of Computer Science.
Recommended reading	Specification of the foreign university
Links	• International Student Office of CvO Universität • Web-Site of the Computer Science Department (in German)

Languages of instruction	English , French, German
Duration (semesters)	1 Semester
Module frequency	individual
Module capacity	unlimited
Teaching/Learning method	Requirement of the foreign university

Examination	Prüfungszeiten	Type of examination
Final exam of module		Specification of the foreign university Recognition must be applied for at the Academic Examinations Office. Transcripts of records from courses attended at the foreign university must be submitted in German or English translation.

Type of course	Course selection
SWS	0
Frequency	--
Workload attendance time	56 h

inf950 - Interdisciplinary Module I

Module label	Interdisciplinary Module I
Module code	inf950
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Interdisziplinäre Module
Responsible persons	• Vogel-Sonnenschein, Ute (module responsibility) • Vogel-Sonnenschein, Ute (Module counselling) • Lehrenden, Die im Modul (authorised to take exams)
Further responsible persons	Studiengangsverantwortliche der Master-Studiengänge Informatik und Wirtschaftsinformatik
Prerequisites	Depending on the allocated course
Skills to be acquired in this module	The graduates know the basics and the application-relevant application-relevant background of the selected discipline. **Professional competencies** The students: • identify the fundamentals and methods of the chosen field • use the technical language of the field of application competently **Methodological competencies** The students: • characterize the context of use and requirements of IT in the chosen field • apply the disciplinary methods and techniques of the application area and contrast them with the methods and techniques • known from methods and techniques • known from computer science • investigate problems of an application area with the methods and techniques typical for the discipline methods **Social competencies** The students: • can appreciate the diversity of subject cultures and • respect other disciplines and their way of working • prepare themselves for application scenarios for IT systems **Self-competences** The students: • reflect on their self-image and actions against the background of a other subject discipline
Module contents	The module is instantiated with specialist modules from other disciplines or modules from the Department of Computer Science, which provide an interdisciplinary insight into another scientific discipline. The types of courses and examination modalities depend on the module selected.
Recommended reading	Depending on the allocated course
Links	

Languages of instruction	English , German	
Duration (semesters)	1 Semester	
Module frequency	irregular	
Module capacity	unlimited	
Teaching/Learning method	events from V, S, Ü, P	
Examination	Prüfungszeiten	Type of examination
Final exam of module		
		Depending on the allocated course

Type of course	Course selection
SWS	4
Frequency	--
Workload attendance time	56 h

Module aus anderen Studiengängen

mat996 - Introduction to Numerical Analysis

Module label	Introduction to Numerical Analysis
Module code	mat996
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Bachelor's Programme Business Informatics (Bachelor) > Aufbaucurriculum-Wahlbereich Mathematik • Bachelor's Programme Computing Science (Bachelor) > Wahlpflichtbereich Mathematik • Master's Programme Computing Science (Master) > Module aus anderen Studiengängen
Responsible persons	• Chernov, Alexey (module responsibility) • Schöpfer, Frank (module responsibility)
Prerequisites	Analysis I, Lineare Algebra
Skills to be acquired in this module	The students learn and analyze the basic numerical methods. The students learn to implement the basic numerical methods in a computer program. Professional competence The students: · learn basic numerical methods and algorithms · analyze properties of the numerical methods using rigorous mathematical tools · implement the basic numerical methods in a computer program · interpret results of computer simulations Methodological competence The students: · analyze algorithms with mathematical tools · implement numerical algorithms for concrete problems Social competence The students: · develop solutions to given problems in groups · accept constructive criticism Personal competence The students: · reflect their solution strategies · deepen their understanding of the presented mathematical and algorithmical concepts with exercises and adopt the solution methods
Module contents	· Numerical methods for linear systems: LU-, Cholesky decompositions, iterative methods · Numerical methods for nonlinear equations: fix-point iterations, Netwon's Method · Polynomials, spline and trigonometric interpolation · Numerical integration: Newton-Cotes, Gauss quadrature rules, adaptive quadrature and extrapolation methods · Stability and conditioning of algorithms and problems
Recommended reading	R. Plato: Numerische Mathematik kompakt, Vieweg + Teubner, 2010. Stoer, Bulirsch: Numerische Mathematik 1 und 2, Springer, 2007, 2005. P. Deuflhard, A. Hohmann: Numerische Mathematik 1, de Gruyter, 2008. H.R. Schwarz, N. Köckler: Numerische Mathematik, Vieweg+Teubner, 2008. M. Hanke-Bourgeois: Grundlagen der Numerischen Mathematik und des Wissenschaftlichen Rechnens, Vieweg+Teubner, 2008.
Links	
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	every year
Module capacity	unlimited
Reference text	Als 6 KP Modul werden Vorlesung und Übungen nur in den ersten 2/3 des Semesters besucht.

Examination	Prüfungszeiten	Type of examination

Examination		Prüfungszeiten	Type of examination	
Final exam of module		At the end of the lecture period written exam	Final exam of module	
Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2.7	WiSe	37
Exercises		1.3	WiSe	19
Total module attendance time				56 h

mat997 - Introduction to Probability and Statistics

Module label	Introduction to Probability and Statistics
Module code	mat997
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Bachelor's Programme Computing Science (Bachelor) > Wahlpflichtbereich Mathematik • Master's Programme Computing Science (Master) > Module aus anderen Studiengängen
Responsible persons	• Christiansen, Marcus (module responsibility) • Ruckdeschel, Peter (module responsibility) • May, Angelika (module responsibility)
Prerequisites	
Skills to be acquired in this module	- Exemplarisches Kennenlernen weiterer mathematischer Gebiete und damit Erweiterung des eigenen mathematischen Wissens - Kennenlernen von schulrelevanten Anwendungen - Vertiefung, auch exemplarisch, der im Grundlagenbereich erworbenen Kenntnisse - Vernetzung des eigenen mathematischen Wissens durch Herstellung von Bezügen zwischen verschiedenen mathematischen Bereichen - Aufbau von Grundkenntnissen in Wahrscheinlichkeitstheorie und Statistik - Vertiefung und Erweiterung der im Grundlagenbereich erworbenen Kenntnisse aus Analysis und Linearer Algebra - Kennenlernen von schulrelevanten Anwendungen im Bereich diskreter Wahrscheinlichkeitsräume und statistischer Hypothesen - Kennenlernen von mathematischen Grundlagen der Wahrscheinlichkeitstheorie und Einblicke in die Statistik - Vernetzung des eigenen mathematischen Wissens durch Verknüpfung wahrscheinlichkeitstheoretischer Konzepte mit Inhalten aus Analysis I und II sowie der Linearen Algebra
Module contents	Grundzüge der Maß- und Integrationstheorie, Wahrscheinlichkeitsräume, Zufallsvariablen/-vektoren und ihre Verteilung, Dichte und Verteilungsfunktion, stochastische Unabhängigkeit, Erwartungswert, Varianz und Kovarianz, bedingte Wahrscheinlichkeiten/Erwartungen, multivariate Normalverteilung, Grenzwertsätze: Gesetz der großen Zahlen und Zentraler Grenzwertsatz
Recommended reading	Andreas Büchter, Hans-Wolfgang Henn: Elementare Stochastik, Springer Herold Dehling, Beate Haupt: Einführung in die Wahrscheinlichkeitstheorie und Statistik, Springer
Links	
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	jährlich
Module capacity	unlimited
Reference text	Als 6 KP Modul werden Vorlesung und Übungen nur in den ersten 2/3 des Semesters besucht.

Examination	Prüfungszeiten	Type of examination
Final exam of module	Klausur am Ende des Semesters	KL

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2	SuSe	28
Exercises		2	SuSe	28
Total module attendance time				56 h

wir021 - Double Entry Bookkeeping & Financial Statements under German Law (HGB)

Module label	Double Entry Bookkeeping & Financial Statements under German Law (HGB)
Module code	wir021
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Bachelor's Programme Business Administration and Law (Bachelor) > Basiscurriculum Wirtschaftswissenschaften • Bachelor's Programme Business Informatics (Bachelor) > Aufbaucurriculum - Pflichtbereich • Bachelor's Programme Comparative and European Law (Bachelor) > Module • Bachelor's Programme Economics and Business Administration (Bachelor) > Basismodule • Bachelor's Programme Mathematics (Bachelor) > Nebenfachmodule • Bachelor's Programme Sustainability Economics (Bachelor) > Wahlpflichtbereich • Dual-Subject Bachelor's Programme Economics and Business Administration (Bachelor) > Basismodule • Master's Programme Computing Science (Master) > Module aus anderen Studiengängen
Responsible persons	• Sextroh, Christoph (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	none
Skills to be acquired in this module	Participants… 1. understand financial accounting as the basis of corporate data and bookkeeping 2. gain comprehensive knowledge of main accounting areas such as procurement, sales, HR, inventory, tax, provisions etc. 3. obtain basic knowledge about annual report process of single entities.
Module contents	The main objective of this module is to give the students an overview of the double entry bookkeeping as well as the link between financial accounting, balance sheet and income statement. The acquisition of basis knowledge of the corporate accountancy stands in the foreground, for example, how organizations manage the bookkeeping, legal basis of the annual accounts, creating an inventory, content of accounting and income statement.
Recommended reading	Coenenberg et al. (2014): Einführung in das Rechnungswesen (5. Aufl.), Schäffer-Poeschel, Stuttgart. Döring, U. & Buchholz, R. (2015): Buchhaltung und Jahresabschluss (14. Aufl.), Erich Schmidt, Berlin. An additional script is provided.
Links	http://www.uni-oldenburg.de/accounting/
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	jährlich
Module capacity	unlimited

Examination	Prüfungszeiten	Type of examination
Final exam of module	at the end of the semester	final exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2		28
Tutorial		2	WiSe	28
Total module attendance time				56 h

wir082 - Corporate Finance

Module label	Corporate Finance
Module code	wir082
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Bachelor's Programme Business Administration and Law (Bachelor) > Aufbaubereich Wirtschaftswissenschaften • Bachelor's Programme Business Informatics (Bachelor) > Akzentsetzungsbereich Wirtschaftswissenschaften • Bachelor's Programme Economics and Business Administration (Bachelor) > Akzentsetzungsmodule • Bachelor's Programme Mathematics (Bachelor) > Nebenfachmodule • Bachelor's Programme Sustainability Economics (Bachelor) > Wahlpflichtbereich more... • Dual-Subject Bachelor's Programme Economics and Business Administration (Bachelor) > Aufbaumodule • Dual-Subject Bachelor's Programme Economics and Business Administration (Bachelor) > Schwerpunkt Management und Ökonomie • Master of Education Programme (Vocational and Business Education) Economics and Business Administration (Master of Education) > Mastermodule • Master's Programme Business Informatics (Master) > Module der Wirtschafts- und Rechtswissenschaften (Master) • Master's Programme Computing Science (Master) > Module aus anderen Studiengängen
Responsible persons	• Prokop, Jörg (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	
Skills to be acquired in this module	Students • understand the role corporate finance plays in today’s business environment, • are able to make consistent investment decisions based on established financial models both under certainty and under uncertainty, • are able to place these models in within the broader context of economic theory, including both neoclassical theory and principal-agent theory, • are able to assess the limitations of these models, • analyze firm’s main sources of (long-term) financing.
Module contents	Course outline: 1. Introduction 2. Valuation and Capital Budgeting 3. Risk and Return 4. Long-Term Financing This course is an introduction to corporate finance. It covers typical tools and techniques used in making investment and financing decisions, and it provides insights into their theoretical foundations. The concept of time value of money and net present value is discussed in detail, first under certainty, and then in the presence of uncertainty. We will examine the relationship between an investment’s risk and its return, and discuss ways to derive risk-adjusted cost of equity capital. In addition, the course provides insights into firms’ main sources of (long-term) financing. The topics covered in this course are relevant for financial decision-making in various areas of business management, including operations management, marketing, and in particular corporate strategy.
Recommended reading	Main textbook: Hillier, Ross, Westerfield, Jaffe & Jordan, Corporate Finance, current edition, McGraw-Hill (especially chapters 1, 2, 4-10, 14). Supplementary readings: Berk & DeMarzo, Corporate Finance, current edition, Boston (Mass.). Brealey, Myers & Allen, Principles of Corporate Finance, current edition, Boston (Mass.). Schmidt und Terberger, Grundzüge der Investitions- und Finanzierungstheorie (4. Aufl.), 1997, Wiesbaden.
Links	http://www.uni-oldenburg.de/fiwi_bbl/
Language of instruction	English
Duration (semesters)	1 Semester

Module frequency		jährlich		
Module capacity		unlimited		
Examination		Prüfungszeiten	Type of examination	
Final exam of module		within three weeks after the last lecture	written exam	

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2		28
Tutorial		2		28
Total module attendance time				56 h

wir160 - Entrepreneurship

Module label	Entrepreneurship
Module code	wir160
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Bachelor's Programme Business Administration and Law (Bachelor) > Aufbaubereich Wirtschaftswissenschaften • Bachelor's Programme Business Informatics (Bachelor) > Akzentsetzungsbereich Wirtschaftswissenschaften • Bachelor's Programme Business Informatics (Bachelor) > Wahlbereich Informatik, Kultur und Gesellschaft • Bachelor's Programme Computing Science (Bachelor) > Wahlbereich Informatik, Kultur und Gesellschaft • Bachelor's Programme Economics and Business Administration (Bachelor) > Studienrichtung Betriebswirtschaftslehre • Bachelor's Programme Sustainability Economics (Bachelor) > Wahlpflichtbereich • Master of Education Programme (Vocational and Business Education) Economics and Business Administration (Master of Education) > Mastermodule • Master's Programme Business Informatics (Master) > Module der Wirtschafts- und Rechtswissenschaften (Master) • Master's Programme Computing Science (Master) > Module aus anderen Studiengängen
Responsible persons	• Lehrenden, Die im Modul (authorised to take exams) • Nicolai, Alexander (module responsibility)
Prerequisites	none
Skills to be acquired in this module	The module introduces to the basics of Entrepreneurship Upon completion of the module, students will be able to: - understand the challenges of launching an enterprise, - strategically analyse the structure of market - understand how employees are able to behave like an entrepreneur in established enterprises - develop innovative business ideas - shape the key factors for realizing a business idea - demonstrate a knowledge of the entrepreneurial process - demonstrate a knowledge of cost accounting (especially break-even analysis, etc.) and will be able to calculate costs by themselves - analyse and evaluate business models
Module contents	The module combines the lecture “Strategie und Entrepreneurship” with a tutorial. It investigates the challenges of launching enterprises and entrepreneurial behaviour in large companies as well. The content of the module follows the process of an entrepreneur. It starts with business ideas, their perception, and evaluation. In addition, it deals with the most important questions of development and management of new business models. The contents of the courses include the following topics: - historical, institutional, and theoretical context - development, evaluation, and pitching ideas - business models - building entrepreneurial teams - entrepreneurship in large enterprises - resources and finance - management of growth
Recommended reading	Corsten, H. (Hrsg.) (2002): Dimensionen der Unternehmensgründung. Berlin: Schmidt. Klandt, H. (2005): Gründungsmanagement (2. Aufl.), Oldenbourg, München. Fueglistaller, Urs/Müller, Chrsitoph/Müller, Susan/Volery, Thierry (2016): Entrepreneurship. Modelle – Umsetzung – Perspektiven. Mit Fallbeispielen aus Deutschland, Österreich und der Schweiz (4. Auflage), Gabler Verlag/Springer Fachmedien, Wiesbaden. Grichnik, Dietmar/Brettel, Malte/Koropp, Christian/Mauer, René (2010): Entrepreneurship. Unternehmerisches Denken, Entscheiden und Handeln in innovativen und technologieorientierten Unternehmungen. Schäffer-Pöschel Verlag, Stuttgart. Grant, R. M., Nippa, M. (2006): Strategisches Management: Analyse, Entwicklung und Implementierung von Unternehmensstrategien (5. Aufl.), Pearson Studium, München.

Links	http://www.uni-oldenburg.de/wire/entrepreneurship/lehrangebot/veranstaltungen/lehrangebot-wise-20162017/
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	jährlich
Module capacity	unlimited
Reference text	The lecture “Strategie und Entrepreneurship” must be attended in combination with the “Tutorium”.

Examination	Prüfungszeiten	Type of examination
Final exam of module	at the end of the semester	written exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Course or seminar		2	WiSe	28
Tutorial		2		28
Total module attendance time				56 h

wir210 - Corporate Environmental Management

Module label	Corporate Environmental Management
Module code	wir210
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Bachelor's Programme Business Administration and Law (Bachelor) > Aufbaubereich Wirtschaftswissenschaften • Bachelor's Programme Business Informatics (Bachelor) > Akzentsetzungsbereich Wirtschaftswissenschaften • Bachelor's Programme Business Informatics (Bachelor) > Wahlbereich Informatik, Kultur und Gesellschaft • Bachelor's Programme Computing Science (Bachelor) > Wahlbereich Informatik, Kultur und Gesellschaft • Bachelor's Programme Economics and Business Administration (Bachelor) > Studienrichtung Betriebswirtschaftslehre more... • Bachelor's Programme Economics and Business Administration (Bachelor) > Studienrichtung Ökologie und Nachhaltigkeit • Bachelor's Programme Sustainability Economics (Bachelor) > Wahlpflichtbereich • Master of Education Programme (Vocational and Business Education) Economics and Business Administration (Master of Education) > Mastermodule • Master's Programme Business Informatics (Master) > Module der Wirtschafts- und Rechtswissenschaften (Master) • Master's Programme Computing Science (Master) > Module aus anderen Studiengängen
Responsible persons	• Siebenhüner, Bernd (module responsibility) • Lehrenden, Die im Modul (Module counselling)
Prerequisites	
Skills to be acquired in this module	The students: • understand the goals and concepts of sustainable development; • discuss the importance of sustainability for companies; • know basic strategies and instruments that enable companies to achieve sustainable development; • acquire conceptual and practical skills using case studies, in particular about which instruments can be used to prepare companies for the challenges of sustainable development.
Module contents	The module consists of a lecture and a seminar. While the lecture presents and explains concepts, instruments and strategies for sustainable development, the seminar focuses on the practical relevance of the various instruments, concepts and strategies and discusses these based on case studies. • Concepts and goals of sustainable development • Introduction to the current discussion on sustainable development • Current sustainability instruments and strategies for companies • Case studies
Recommended reading	• Baumast, A. & Pape, J. (Hrsg.) (2009): Betriebliches Umweltmanagement. Nachhaltiges Wirtschaften im Unternehmen (4. Aufl.). Stuttgart: Ulmer • Dyllick, T. & Hockerts, K. (2002): Beyond the Business Case for Corporate Sustainability. In: Business Strategy and the Environment, S. 130-141 • Holliday, C. et al. (2002): Walking the Talk. The Business Case for Sustainable Development. Sheffield: Greenleaf • Pfriem, R.; Fichter, K. & Paech, N. (2005): Nachhaltige Zukunftsmärkte - Orientierungen für unternehmerische Innovationsprozesse im 21. Jahrhundert. Marburg: Metropolis • Siebenhüner, B. et al. (2006): Organisationales Lernen und Nachhaltigkeit. Marburg: Metropolis.
Links	https://www.uni-oldenburg.de/wire/
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	jährlich
Module capacity	unlimited

Examination		Prüfungszeiten		Type of examination
Final exam of module		usually around Mid of March		HA

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2		28
Seminar		2		28
Total module attendance time				56 h

wir270 - Resource and Energy Economics

Module label	Resource and Energy Economics
Module code	wir270
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Bachelor's Programme Economics and Business Administration (Bachelor) > Studienrichtung Ökologie und Nachhaltigkeit • Bachelor's Programme Economics and Business Administration (Bachelor) > Studienrichtung Volkswirtschaftslehre • Bachelor's Programme Sustainability Economics (Bachelor) > Vertiefungsmodule • Master's Programme Computing Science (Master) > Module aus anderen Studiengängen
Responsible persons	• Böhringer, Christoph (module responsibility) • Asane-Otoo, Emmanuel (module responsibility) • Lehrenden, Die im Modul (authorised to take exams) • Asane-Otoo, Emmanuel (Module counselling)
Prerequisites	Keine
Skills to be acquired in this module	Die Studierenden sind in der Lage: • Ressourcen- und energieökonomische Standardmodelle nachzuvollziehen, • Standardmodelle in Hinblick auf weitergehende Fragestellungen anzupassen bzw. zu erweitern, • die Funktionsweise von Ressourcen- und Energiemärkten zu verstehen, • reale Vorgänge auf Ressourcen- und Energiemärkten anhand der Kriterien Effizienz, Verteilung und Nachhaltigkeit zu bewerten, • die institutionell-regulatorischen Rahmenbedingungen von Ressourcen- und Energiemärkten anhand der Kriterien Effizienz, Verteilung und Nachhaltigkeit zu bewerten.
Module contents	Behandelt werden die Themenlinien nicht regenerierbare Ressourcen (effiziente Nutzung, intertemporale Gerechtigkeit, intertemporales Marktgleichgewicht); regenerierbare Ressourcen (effiziente Nutzung im steady state, Marktgleichgewicht); Nachhaltigkeit; Grundlagen der Energiewirtschaft; Energienachfrage; Energie und Umwelt; Energieressourcen; Märkte für Primärenergieträger; Strommarkt und Regulierung. Dabei stehen die volkswirtschaftlichen Aspekte im Zentrum, wobei notwendigerweise auch grundlegende technische und betriebswirtschaftliche Aspekte vermittelt werden.
Recommended reading	Endres, A. & Querner, I. (2000), Die Ökonomie natürlicher Ressourcen, Kohlmeyer, Stuttgart. Field, B.C. (2008), Natural Resource Economics: An Introduction, Waveland Press, Long Grove, Ill. Erdmann, G & Zweifel, P. (2008): Energieökonomik - Theorie und Anwendungen, Springer, Heidelberg Stoft, S. (2002), Power System Economics, Wiley, Piscataway.
Links	https://www.uni-oldenburg.de/wire/
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	jährlich
Module capacity	unlimited

Examination	Prüfungszeiten	Type of examination
Final exam of module	Zum Ende der Vorlesungszeit	KL

Type of course	Lecture
SWS	4
Frequency	
Workload attendance time	56 h

wir360 - Environmental and Sustainability Policies

Module label	Environmental and Sustainability Policies
Module code	wir360
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Bachelor's Programme Business Informatics (Bachelor) > Akzentsetzungsbereich Wirtschaftswissenschaften • Bachelor's Programme Economics and Business Administration (Bachelor) > Studienrichtung Ökologie und Nachhaltigkeit • Bachelor's Programme Sustainability Economics (Bachelor) > Vertiefungsmodule • Master's Programme Computing Science (Master) > Module aus anderen Studiengängen
Responsible persons	• Lehrenden, Die im Modul (authorised to take exams) • Siebenhüner, Bernd (Module counselling) • Siebenhüner, Bernd (module responsibility)
Prerequisites	none
Skills to be acquired in this module	students: • have basic information about national and European environmental and sustainability governance • describe the history of national and European environmental and sustainability governance • reflect upon central principles, instruments, players and strategies in environmental and sustainability governance
Module contents	Development directions of German and European environmental and sustainability governance; Analysis of selected topics like energy, agriculture, chemical industry etc.; Principles of environmental and sustainability governance; Instruments of environmental and sustainability governance compared on international level; New mechanisms in governance; Relevant actors of environmental and sustainability governance (administration, industry, media, science, NGOs etc.); International environmental and sustainability governance
Recommended reading	Aden, Hartmut (2012): Umweltpolitik, Wiesbaden: VS-Verlag Jänicke, M. (1997): National Environmental Policies. Heidelberg: Springer Jänicke, M. et al. (1999): Lern- und Arbeitsbuch Umweltpolitik. Bonn: Dietz Jordan, A. (Hrsg.) (2004): Environmental Policy in the European Union: Actors, Institutions and Processes. London: Earthscan. Kraft, Michael E. (2011): Environmental policy and politics. 5th ed. Upper Saddle River: Pearson Education
Links	https://www.uni-oldenburg.de/wire/
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	yearly
Module capacity	unlimited

Examination	Prüfungszeiten	Type of examination
Final exam of module		presentation

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2		28
Seminar		2		28
Total module attendance time				56 h

wir806 - Information Technology Law

Module label	Information Technology Law
Module code	wir806
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Bachelor's Programme Business Informatics (Bachelor) > Wahlbereich Informatik, Kultur und Gesellschaft • Bachelor's Programme Computing Science (Bachelor) > Wahlbereich Informatik, Kultur und Gesellschaft • Master Applied Economics and Data Science (Master) > Specialization • Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Pflichtmodule • Master of Education Programme (Hauptschule and Realschule) Computing Science (Master of Education) > Mastermodule more... • Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) > Recht und Gesellschaft • Master's Programme Business Administration, Economics and Law (Master) > Basismodule • Master's Programme Business Administration, Economics and Law (Master) > Mantelmodule (MPO2020) • Master's Programme Business Administration, Economics and Law (Master) > Schwerpunktmodule RdW - Recht • Master's programme Business Administration: Management and Law (Master) > Basismodule • Master's programme Business Administration: Management and Law (Master) > Schwerpunktmodule RdW - Recht • Master's Programme Business Informatics (Master) > Module der Wirtschafts- und Rechtswissenschaften (Master) • Master's Programme Computing Science (Master) > Module aus anderen Studiengängen
Responsible persons	• Rott, Peter (module responsibility) • Lehrenden, Die im Modul (authorised to take exams) • Rott, Peter (Module counselling)
Prerequisites	not applicable
Skills to be acquired in this module	The students are familiar with the effects of digitalisation with its chances and risks in European and German private law and, in particular, consumer law. They obtain knowledge of specific areas of digitalised private law and consumer law with particular relevance for their future professional practice, are able to solve consumer law cases in a goal-oriented way, are able to find approaches for legal problems as well as recognise liability risks and how to deal with them, and are, in contract negotiations, able to recognise the requirements for regulation and to evaluate its consequences
Module contents	This module conveys how new technologies impact on private law and, in particular, on consumer law. It focuses on the (modified) interpretation of existing laws but even more on the reactions of the EU and national legislators and of the judiciary to new technological developments. The module discusses, among others, distance selling law, digitalised sales law and product liability law, the law of digital content and digital services, unfair commercial practices on internet and the law of the platform economy. Finally, the module looks at enforcement.
Recommended reading	to be announced in the first lecture
Links	
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	jährlich
Module capacity	unlimited
Type of module	Wahlpflicht / Elective
Module level	MM (Mastermodul / Master module)
Teaching/Learning method	Lecture and Seminar

Previous knowledge		basic knowledge of civil law is helpful.		
Examination	Prüfungszeiten		Type of examination	
Final exam of module			to be taken from the examination regulations	
Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2		28
Seminar		2		28
Total module attendance time				56 h

wir808 - Multivariate Statistics

Module label	Multivariate Statistics
Module code	wir808
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Administration, Economics and Law (Master) > Basismodule • Master's Programme Business Administration, Economics and Law (Master) > Mantelmodule (MPO2020) • Master's Programme Business Administration, Economics and Law (Master) > Schwerpunkt "Volkswirtschaftslehre" (VWL) (MPO2020) • Master's programme Business Administration: Management and Law (Master) > Basismodule • Master's Programme Business Informatics (Master) > Module der Wirtschafts- und Rechtswissenschaften (Master) • Master's Programme Computing Science (Master) > Module aus anderen Studiengängen • Master's Programme Environmental Modelling (Master) > Mastermodule • Master's Programme Sustainability Economics and Management (Master) > Basic Modules
Responsible persons	• Stecking, Ralf Werner (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	
Skills to be acquired in this module	With successful completion of the course, students shall: • be aware of and be able to evaluate advanced methods of multivariate data analysis. • be able to select adequate methods in relevant fields of application, like prediction, classification, and segmentation analysis. • be able to run computer-aided analyses and to interpret the results properly.
Module contents	Various methods of quantitative data analysis such as: • Linear Regression, • Logistic Regression, • Linear Discriminant Analysis, • Principal Component Analysis, • Feature selection and evaluation methods.
Recommended reading	Backhaus, Erichson, Plinke, Weiber (2015): Multivariate Analysemethoden, 14. Aufl., Springer, Berlin Litz, H.P. (2000): Multivariate Statistische Methoden, Oldenbourg, München Hartung, J. und Elpelt, B. (2006): Multivariate Statistik, 7. Aufl., Oldenbourg, München Berthold, M. und Hand, D.J. (2010): Intelligent Data Analysis, 2. Aufl., Springer, Berlin Witten, I.H. und Frank, E. (2011): Data Mining, 3. Aufl., Morgan Kaufmann, San Francisco
Links	
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	jährlich
Module capacity	unlimited

Examination	Prüfungszeiten	Type of examination
Final exam of module	at the end of the semester	written exam or oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2		28
Exercises		2		28

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Total module attendance time				56 h

wir812 - Environmental Law

Module label	Environmental Law
Module code	wir812
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Administration, Economics and Law (Master) > Basismodule • Master's Programme Business Administration, Economics and Law (Master) > Mantelmodule (MPO2020) • Master's Programme Business Administration, Economics and Law (Master) > Schwerpunktmodule NM-Recht • Master's Programme Business Administration, Economics and Law (Master) > Schwerpunktmodule RdW - Recht • Master's programme Business Administration: Management and Law (Master) > Basismodule more... • Master's programme Business Administration: Management and Law (Master) > Schwerpunktmodule NM-Recht • Master's programme Business Administration: Management and Law (Master) > Schwerpunktmodule RdW - Recht • Master's Programme Business Informatics (Master) > Module der Wirtschafts- und Rechtswissenschaften (Master) • Master's Programme Computing Science (Master) > Module aus anderen Studiengängen • Master's Programme Sustainability Economics and Management (Master) > Basic Modules
Responsible persons	• Meyerholt, Ulrich (Module counselling) • Godt, Christine (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	
Skills to be acquired in this module	Building on the existing knowledge of the participants, the course will deepen knowledge of European and international law, whereby emphasis will be laid on those areas in which the dividing line between state intervention (public law) and market rights (private law) has become blurred. Students will be able to analyze contemporary regulatory techniques inherent in the multilevel system of governance and to assess them from an interdisciplinary (economic and legal) perspective.
Module contents	The module comprises two courses, one of which will be taught by PD Dr. Meyerholt, and the other together with Prof. Godt. The first course deals with selected issues in environmental law. With the general structure of environmental law as a point of departure, the course content will be taught in a holistic manner that will also incorporate the leading decisions of the higher courts. The second course takes into consideration intra-disciplinary environmental law as situated between public and private economic law, whereby special focus will be laid on the European and international dimensions.
Recommended reading	Epiney, A. (2013), Umweltrecht der Europäischen Union, Nomos, Baden-Baden. Erbguth, W./Schlacke, S., (2016), Umweltrecht, 6. Aufl., Nomos, Baden-Baden. Jans, J./Vedder, H. (2012), European Environmental Law, 4. Aufl., Europa Law Publishing, Groningen. Meyerholt, U. (2016), Umweltrecht, 4. Aufl. BIS-Vlg, Oldenburg.
Links	
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	jährlich
Module capacity	unlimited

Examination	Prüfungszeiten	Type of examination
Final exam of module	during term	oral presentation and written script

Type of course	Lecture
SWS	4
Frequency	SuSe or WiSe
Workload attendance time	56 h

wir814 - Strategic Management

Module label	Strategic Management
Module code	wir814
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Administration, Economics and Law (Master) > Mantelmodule (MPO2020) • Master's Programme Business Administration, Economics and Law (Master) > Schwerpunkt "China - Wirtschaft und Sprache" (CHI) - Kernmodule (MPO2020) • Master's Programme Business Administration, Economics and Law (Master) > Schwerpunktmodule RdW - BWL • Master's Programme Business Administration, Economics and Law (Master) > Schwerpunktmodule UF - BWL • Master's programme Business Administration: Management and Law (Master) > Schwerpunktmodule RdW - BWL • Master's programme Business Administration: Management and Law (Master) > Schwerpunktmodule UF - BWL • Master's Programme Business Informatics (Master) > Module der Wirtschafts- und Rechtswissenschaften (Master) • Master's Programme Computing Science (Master) > Module aus anderen Studiengängen
Responsible persons	• Hoppmann, Jörn (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	Keine
Skills to be acquired in this module	Students... - Know advanced theoretical concepts, research streams, and frameworks of in the field of Strategic Management - Understand the links between different theories and are able to critically question them - Can apply theories to understand and interpret organizational dynamics in daily life - Are able to develop solutions for concrete practical challenges in companies in the context of Strategic Management based on the concepts and frameworks they have learned - Can put the newly acquired knowledge into a broader context, so it can be deepened in the further professional life
Module contents	The course offers an overview of advanced concepts and frameworks in the feld of Strategic Management. At the beginning, the course will provide a brief introduction into the historical development, goals, and research streams of the field. In this context, important terms, methods, and philosophical approaches of (management) research will be clarified. Subsequently, students form groups to analyze selected scientific articles with regard to their theoretical relevance and practical implications. Theoretical topics that will be covered in depth are: 1. Top Management Teams, Upper Echelons und Corporate Governance 2. Ressource- and Capability-based Approaches 3. Resource Dependence Theory, Stakeholder Theory and Co-Evolution 4. Institutional Theory, Institutional Work/Entrepreneurship and Social Movements 5. Organizational Cognition, Identity, and Framing 6. Organizational Learning and Ambidexterity 7. Organizational networks and ecosystems The results of the analysis will be summarized in a seminar thesis, presented in class, and discussed with the other students. The main goal of the course is to equip students with advanced concepts, which allow them to understand organizational dynamics, question established practices in firms, and develop new solutions that go beyond the application of standard instruments.
Recommended reading	Bingham, C. B., & Davis, J. P. (2012). Learning sequences: Their existence, effect, and evolution. Academy of Management Journal, 55(3), 611-641. Danneels, E. (2011). Trying to become a different type of company: Dynamic capability at Smith Corona. Strategic Management Journal, 32(1), 1-31. Garud, R., Jain, S., & Kumaraswamy, A. (2002). Institutional entrepreneurship in the sponsorship of common technological standards: The case of Sun Microsystems and Java. Academy of Management Journal, 45(1), 196-214. Gilbert, C. G. (2005). Unbundling the structure of inertia: Resource versus routine rigidity. Academy of Management Journal, 48(5), 741-763. Gioia, D. A., & Chittipeddi, K. (1991). Sensemaking and sensegiving in strategic change initiation. Strategic Management Journal, 12(6), 433-448. Hannah, D. P., & Eisenhardt, K. M. (2017). How firms navigate cooperation and competition in nascent ecosystems. Strategic Management Journal, in

	press. Hoppmann, J., Naegele, F. & Girod, B. (2018). Boards as a source of inertia: Examining the internal challenges and dynamics of boards of directors in times of environmental discontinuities. Working Paper. Murmann, J. P. (2013). The coevolution of industries and important features of their environments. Organization Science, 24(1), 58-78. Ossenbrink, J., Hoppmann, J., Hoffmann, V. (2018). Hybrid ambidexterity: How the environment shapes incumbents' use of structural and contextual approaches. Working Paper. Tripsas, M., & Gavetti, G. (2000). Capabilities, cognition, and inertia: Evidence from digital imaging. Strategic Management Journal, 21(10/11), 147-1161. Vuori, T. O., & Huy, Q. N. (2016). Distributed attention and shared emotions in the innovation process: How Nokia lost the smartphone battle. Administrative Science Quarterly, 61(1), 9-51.
Links	
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	jährlich
Module capacity	unlimited

Examination	Prüfungszeiten	Type of examination
Final exam of module	Zum Ende des Semesters	KL

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2		28
Seminar		2		28
Total module attendance time				56 h

wir857 - Law of Media and Telecommunication

Module label	Law of Media and Telecommunication
Module code	wir857
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Administration, Economics and Law (Master) > Schwerpunktmodule RdW - Recht • Master's Programme Business Administration, Economics and Law (Master) > Schwerpunktmodule UF - Recht • Master's Programme Business Administration, Economics and Law (Master) > Schwerpunkt "Recht der Wirtschaft" (RdW) (MPO2020) • Master's programme Business Administration: Management and Law (Master) > Schwerpunktmodule RdW - Recht • Master's programme Business Administration: Management and Law (Master) > Schwerpunktmodule UF - Recht • Master's Programme Business Informatics (Master) > Module der Wirtschafts- und Rechtswissenschaften (Master) • Master's Programme Computing Science (Master) > Module aus anderen Studiengängen
Responsible persons	• Boehme-Neßler, Volker (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	
Skills to be acquired in this module	The students: have in-depth insights into the economic conditions of media production, distribution and exploitation. know the legal basis and framework conditions of media production, media presentation and mediation (e.g. copyrights, performance rights, distribution of media). bring together economic and legal dimensions of media work. know the economic and legal framework conditions of media institutions (e.g. television, radio, media mediation).
Module contents	This module is about making a connection of the theoretical and practical acquired aesthetic competences with the economic and legal framework conditions. In the sense of professionalisation, prospective media producers and mediators should learn to assess their own future activities under economic and legal conditions.
Recommended reading	Current case law and: Fechner, Medienrecht, 19.Aufl. 2018 Fechner, Entscheidungen zum Medienrecht, 2010. Beater, Medienrecht, 2. Aufl. 2016 Petersen, Medienrecht, 2010.
Links	http://www.integrated-media.de/
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	jährlich
Module capacity	unlimited

Examination	Prüfungszeiten	Type of examination
Final exam of module	At the end of the term	Presentation with term paper

Type of course	Lecture
SWS	4
Frequency	SuSe
Workload attendance time	56 h

wir860 - Data Protection Law

Module label	Data Protection Law
Module code	wir860
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Administration, Economics and Law (Master) > Schwerpunktmodule RdW - Recht • Master's Programme Business Administration, Economics and Law (Master) > Schwerpunktmodule UF - Recht • Master's Programme Business Administration, Economics and Law (Master) > Schwerpunkt "Recht der Wirtschaft" (RdW) (MPO2020) • Master's programme Business Administration: Management and Law (Master) > Schwerpunktmodule RdW - Recht • Master's programme Business Administration: Management and Law (Master) > Schwerpunktmodule UF - Recht • Master's Programme Business Informatics (Master) > Module der Wirtschafts- und Rechtswissenschaften (Master) • Master's Programme Computing Science (Master) > Module aus anderen Studiengängen
Responsible persons	• Lehrenden, Die im Modul (authorised to take exams) • Rott, Peter (module responsibility)
Prerequisites	
Skills to be acquired in this module	Upon completion of the module, students will be able to: • recognize simple data protection incidents. • apply existing protection mechanisms. • implement projects in accordance with the law. • discuss and defend their plans in front of others.
Module contents	The module gives an overview on data protection laws. Basic knowledge of data protection regulations (DSGVO; BDSG) and existing protection mechanisms is imparted. Within the framework of the seminar, the discussed topics will be deepened with the help of seminar papers and individual aspects will be discussed in more detail. The event will highlight the new informational structures in modern society and their effects on data protection and data security. Questions concerning general personal rights, freedom of information, IT security and relevant criminal law regulations will be discussed on the basis of examples and legally provided protection mechanisms as well as the tasks of supervisory authorities will be discussed. In particular, the most important decisions on data protection will be covered in detail during the seminar. At the seminar, students will have the opportunity to prepare in-depth seminar papers on the various topics, which will then be discussed with all participants.
Recommended reading	Kühling/Klar/Sackmann, Datenschutzrecht, 2018. Further literature references will be given in the lecture.
Links	http://www.wto.org/
Language of instruction	German
Duration (semesters)	1 Semester
Module frequency	jährlich
Module capacity	unlimited

Examination	Prüfungszeiten	Type of examination
Final exam of module	typically 6 weeks after your presentation	Seminar paper and presentation or Term paper or Oral exam

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2		28
Seminar		2		28
Total module attendance time				56 h

wir875 - Forecasting Methods

Module label	Forecasting Methods
Module code	wir875
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master Applied Economics and Data Science (Master) > Empirical Methods • Master's Programme Business Administration, Economics and Law (Master) > Schwerpunktmodule UF - VWL • Master's Programme Business Administration, Economics and Law (Master) > Schwerpunkt "Volkswirtschaftslehre" (VWL) (MPO2020) • Master's programme Business Administration: Management and Law (Master) > Schwerpunktmodule UF - VWL • Master's Programme Business Informatics (Master) > Module der Wirtschafts- und Rechtswissenschaften (Master) • Master's Programme Computing Science (Master) > Module aus anderen Studiengängen
Responsible persons	• Stecking, Ralf Werner (module responsibility) • Lehrenden, Die im Modul (authorised to take exams)
Prerequisites	
Skills to be acquired in this module	With successful completion of the course, students shall: • be aware of and be able to evaluate quantitative forecasting methods. • be able to select adequate methods in relevant fields of application, like time series and classification analysis. • be able to run computer-aided analyses and to interpret the results properly.
Module contents	Various aspects of quantitative forecasting methods such as: • Time series components, • Trend and seasonal methods, • Stationarity, • Multivariate forecasting methods, • Autoregressive and moving average processes, • Box-Jenkins method.
Recommended reading	Abraham, B. und Ledolter, J. (2005): Statistical Methods for Forecasting, New York Hamilton, J.D. (1994): Time series analysis, Princeton NJ Kohler, U. und Kreuter, F. (2008): Datenanalyse mit Stata : allgemeine Konzepte der Datenanalyse und ihre praktische Anwendung, 3. Aufl., München Kreiß, J.-P. und Neuhaus, G. (2006): Einführung in die Zeitreihenanalyse, Berlin Makridakis, S., Wheelwright, S.C., MacGee, V.E. (1983): Forecasting : methods and applications, New York Neusser, K. (2011): Zeitreihenanalyse in den Wirtschaftswissenschaften, 3. Aufl., Wiesbaden Schira, J. (2016): Statistische Methoden der VWL und BWL, 5. Aufl., München Schlittgen, R. und Streitberg, B.H.J. (2001): Zeitreihenanalyse, München Schlittgen, R. (2001): Angewandte Zeitreihenanalyse, München Thome, H. (2005): Zeitreihenanalyse, München
Links	
Language of instruction	English
Duration (semesters)	1 Semester

Module frequency	halbjährlich	
Module capacity	unlimited	
Examination	Prüfungszeiten	Type of examination
Final exam of module	end of semester	written exam or oral exam or term paper or seminar paper and presentation

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2		28
Exercises		2		28
Total module attendance time				56 h

wir901 - Environmental Economics

Module label	Environmental Economics
Module code	wir901
Credit points	6.0 KP
Workload	180 h (Lecture: 3 SWS (42h) Exercise: 1 SWS (14h))
Applicability of the module	• Master Applied Economics and Data Science (Master) > Economics • Master's Programme Business Administration, Economics and Law (Master) > Schwerpunktmodule NM-VWL • Master's Programme Business Administration, Economics and Law (Master) > Schwerpunkt "Volkswirtschaftslehre" (VWL) (MPO2020) • Master's programme Business Administration: Management and Law (Master) > Schwerpunktmodule NM-VWL • Master's Programme Computing Science (Master) > Module aus anderen Studiengängen • Master's Programme Environmental Modelling (Master) > Mastermodule • Master's Programme Sustainability Economics and Management (Master) > Basic Modules
Responsible persons	• Helm, Carsten (Module counselling) • Lehrenden, Die im Modul (Module counselling) • Lehrenden, Die im Modul (authorised to take exams) • Helm, Carsten (module responsibility)
Prerequisites	Keine
Skills to be acquired in this module	Know and be able to apply fundamental concepts and figures of thought in environmental economics; be able to analyse and evaluate environmental problems and solution approaches; practice scientific methods and the ability to discuss; be able to classify environmental economics in the context of interdisciplinary sustainability research.
Module contents	Economic analysis of environmental impacts (property rights, external effects, market failure); ethical aspects of environmental economics, instruments of environmental policy (tradable permits, taxes, subsidies, liability law); innovation and adaptation of new technologies; international environmental problems.
Recommended reading	Daniel J. Phaneuf and Till Requate. *A Course in Environmental Economics: Theory, Policy, and Practice*. Cambridge University Press, 2016. Roger Perman, Yue Ma, Michael Common, David Maddison and James McGilvray. *Natural Resource and Environmental Economics*. Addison Wesley. 2011 (4th edition).
Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	Annually
Module capacity	unlimited
Type of module	Pflicht o. Wahlpflicht / compulsory or optional
Teaching/Learning method	Lecture and exercise

Examination	Prüfungszeiten	Type of examination
Final exam of module	At the end of the lecture period	Written exam; bonus through solution of exercises

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2		28
Exercises		2		28
Total module attendance time				56 h

wir904 - Environmental and Sustainability Policies

Module label	Environmental and Sustainability Policies
Module code	wir904
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Business Informatics (Master) > Module der Wirtschafts- und Rechtswissenschaften (Master) • Master's Programme Computing Science (Master) > Module aus anderen Studiengängen • Master's programme Social Sciences (Master) > Wahlpflichtmodule anderer Institute und Departments • Master's Programme Sustainability Economics and Management (Master) > Basic Modules
Responsible persons	• Lehrenden, Die im Modul (authorised to take exams) • Siebenhüner, Bernd (Module counselling) • Wegner, Alkje (Module counselling) • Müller, Werner Joachim (Module counselling) • Siebenhüner, Bernd (module responsibility)
Prerequisites	
Skills to be acquired in this module	students: • have basic information about national and european environmental and sustainability governance • describe the history of national and european environmental and sustainability governance • reflect upon central principles, instruments, players and strategies in environmental and sustainability governance • analyze selected topics of environmental and sustainability governance based upon central principles, instruments, players and strategies
Module contents	• Introduction to environmental politics - Politics, Political Science, Policy Analysis • Environment – Terms and Concepts - Historical Foundations of Environmental Politics • Actors, institutions and governance structures; Actors in Environmental Policy • Socio-ecological systems framework • Environmental Policy in Germany • Environmental Policy in the European Union • Steering and principles in environmental policy • Instruments in environmental policy • Policy process and environmental policy • Multilevel and reflexive governance - Multilevel governance • International environmental governance • Science-Policy Interface
Recommended reading	Aden, Hartmut (2012): Umweltpolitik, Wiesbaden: VS-Verlag Ambrus, M./Arts, K./Hey, E./Raulus, H. (Eds.): The Role of ‘Experts’ in International and European Decision-Making Processes. Advisors, Decision Makers or Irrelevant Actors? Cambridge: Cambridge University Press Jänicke, M. (1997): National Environmental Policies. Heidelberg: Springer Jordan, A. (Hrsg.) (2004): Environmental Policy in the European Union: Actors, Institutions and Processes. London: Earthscan. Kraft, Michael E. (2011): Environmental policy and politics. 5th ed. Upper Saddle River: Pearson Education Ostrom, E. (2009): A General Framework for Analyzing Sustainability of Social-Ecological Systems, Science 325: 420 Hooghe, Liesbet and Makrs, Gary (2003). "Unraveling the Central State, but How? Types of Multi-level Governance." American Political Science Review 97(02): 233-243.
Links	https://www.uni-oldenburg.de/wire/
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	halbjährlich
Module capacity	unlimited

Examination	Prüfungszeiten	Type of examination

Examination	Prüfungszeiten	Type of examination
Final exam of module		presentation

Type of course	Lecture and seminar
SWS	4
Frequency	WiSe
Workload attendance time	56 h

wir905 - Environmental Sciences

Module label	Environmental Sciences
Module code	wir905
Credit points	6.0 KP
Workload	180 h
Applicability of the module	• Master's Programme Computing Science (Master) > Module aus anderen Studiengängen • Master's Programme Sustainability Economics and Management (Master) > Basic Modules • Master's Programme Water and Coastal Management (Master) > Science
Responsible persons	• Freund, Holger (Module counselling) • Köster, Jürgen (Module counselling) • Dozent, Gast (Module counselling) • Klenke, Thomas (authorised to take exams) • Freund, Holger (authorised to take exams) • Köster, Jürgen (authorised to take exams) • Klenke, Thomas (module responsibility)
Prerequisites	
Skills to be acquired in this module	The Introduction to processes and systems of the dynamic Earth constituting the foundation for sustainable management is presented to produce: • Knowledge about processes and systems relevant for sustainable management using knowledge and methodologies from all science disciplines in an integrated way. • Skills in elaborating on complex tasks of environmental management using an interdisciplinary science based approach and to present related findings to non-expert audiences. • Lecture room presentations and discussions based on slides and black/white board usage. Short films will be presented to endorse the intended achievements.
Module contents	Lecture: Understanding the Bioplanet Earth (2 contact hours/week) (Vorlesung, 2 LVS: Aufbau und Entwicklungsgeschichte der Erde; Dynamik der Erde: Kreisläufe und Evolutionsprozesse; Lebensraum Boden; Wasser; Klima; Biodiversität; Lagerstätten und Ressourcenerschließung; Ökosysteme der Erde.) Seminar: Cases in Understanding the Bioplanet Earth (2 contact hours/week) Introduction to key processes and to systems dynamics of the Earth representing a planet being alive driven by external and internal forces interacting with biological activities. Topics of the lecture comprise introductions to the evolution of the universe and solar systems, the differentiation and sub-systems of the Earth´s interior, minerals and rock cycle, soils, ocean and climate, evolution and biodiversity, organisms and physiology, water and element cycling plus insights into ecosystems under different climate conditions. The cases are selected in order to (i) highlight certain principles and theories in geo- and biosciences and (ii) exemplify critical objects and phenomena in modern practice of resource and environmental management. This module consists of topical programmes of the Master Cluster Environment and Sustainability.
Recommended reading	A ´foundation material pool´ will be made available online for students and lecturers providing paper books, reports and media covering the topics of the lecture and the cases
Links	
Language of instruction	English
Duration (semesters)	1 Semester
Module frequency	jährlich
Module capacity	unlimited

Examination	Prüfungszeiten	Type of examination
Final exam of module	By the end of the lecture period.	Presentation/discussion and written report on a case; Scientific quality of presentation (40 %) Clarity of presentation and discussion (20 %) Scientific quality of report (40 %)

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance

Type of course	Comment	SWS	Frequency	Workload of compulsory attendance
Lecture		2		28
Seminar		2		28
Total module attendance time				56 h

Abschlussmodul

mam - Master Thesis Module Computer Science

Module label	Master Thesis Module Computer Science
Module code	mam
Credit points	30.0 KP
Workload	900 h
Applicability of the module	• Master's Programme Computing Science (Master) > Abschlussmodul
Responsible persons	• Peter, Andreas (module responsibility) • Lehrenden, Die im Modul (Module counselling)
Prerequisites	no participant requirements
Skills to be acquired in this module	The students prove that they are able to process and solve complex computer science tasks based on gained scientific knowledge and applied research methods. The students successfully implement a task especially by using their acquired professional and methodological knowledge and their professional and social competences. The accompanying seminar is used to discuss the masters thesis methodically and content-related. During the seminar the exchange of research and practical experience fosters the students' ability to discuss and evaluate their thesis with other students and experts. The masters thesis is finished by a colloquium. **Professional competence** The students: • recognise and evaluate applied techniques and methods of their subject and are aware of their limits • design solutions for complex, possibly vaguely defined or unusual computer science tasks/problems and evaluate these with reference to state of the art computer science and technology • identify, structure and solve problems/tasks, also in new or developing subject areas • apply state of the art and innovative methods to solve problems, if necessary from other disciplines • relate knowledge from different disciplines and apply this new knowledge in complex situations • develop complex computer systems, processes and datamodels • are aware of the current limits and contribute to the development of computer science research and technology • discuss and evaluate recent computer science developments **Methodological competence** The students: • identify and develop one or more solutions • evaluate and apply tools, technology and methods sophisticatedly • examine tasks with technical and research literature, write an academic article and present their solutions academically • schedule processes and resources - Apply project management techniques • combine new and original approaches and methods creatively • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research **Social competence** The students: • communicate with users and experts convincingly • take reasonable decisions **Self-competence** The students: • pursue the overall and special computer science development critically • implement innovative professional activities effectively and

independently
- recognise their abilities and extend them purposefully
- reflect their self-perception and actions with regard to professional, methodological and social aspects
- develop and reflect self-developed hypotheses to theories independently
- work in their field independently

Module contents	Independently researched scientific work. The research findings will be presented and discussed in a masters thesis colloquium.
Recommended reading	ist entsprechend des konkreten Themas selbst zu recherchieren
Links	
Languages of instruction	German, English
Duration (semesters)	1 Semester
Module frequency	every semester
Module capacity	unlimited
Teaching/Learning method	S+MA

Examination	Prüfungszeiten	Type of examination
Final exam of module	Individually in consultation with the reviewers and supervisors	Masters thesis, presentation and discussion.

Type of course	Seminar
SWS	2
Frequency	SuSe and WiSe
Workload attendance time	28 h