Identifier	INF-INF-SYS-RN			
Title of the module	**Computer Networks**			
Intended learning outcomes	• Knowledge of the organization, function, and implementation of computer networks • Ability to assess the specific application purpose of network technologies			
Topics	Overview of techniques and protocols for implementing computer networks, network topology, protocol hierarchy, purpose and implementation of protocol layers, network security, flow and congestion control, and applications.			
Teaching and learning methods separated by ECTS credit points	Lecture	4.5 ECTS credit points		
	Practical classes	4.5 ECTS credit points		
ECTS credit points of the module	9 ECTS credit points			
Credit hours		Contact hours per week (total)	Working hours in self-study	Total
	Lecture	3 hours (45 hours)	90 hours	135 hours
	Practical classes	3 hours (45 hours)	90 hours	135 hours
	Total	6 hours (90 hours)	180 hours	270 hours
Period	1 semester			
Frequency	Every summer term			
Record of study				
Prerequisites for the assessment	Successful participation at the practical classes and exercises are prerequisites for the final assessment.			
Assessment methods	Written examination (90 or 120 min) or oral examination (30 min) or other assessment method (announced at the beginning of the course)			
Requirements of the assessment	The assessment covers the learning outcomes of the entire module.			

Identifier	INF-ESS-K			
Title of the module	**Embedded Software System Construction**			
Intended learning outcomes	The students shall be able to evaluate the core components of software for embedded systems and shall be able to modify and develop such software. These skills shall be trained using deeply embedded computer systems that are connected by wireless networks.			
Topics	Foundations of software construction for embedded systems: Starting with an introduction to typical hardware platforms, the course covers the different layers of system software, such as operating systems, middleware, and databases. Representative embedded systems of both the industry and academia are introduced and analyzed with focus on the principles of software construction. The identified commonalities of such systems are the limited resources, such as memory, energy, computing power, network connectivity, and the requirements on real-time, dependability, and context-aware behavior. The course highlights representative development methods and programming techniques for such systems.			
Teaching and learning methods separated by ECTS credit points	Lecture	6 ECTS credit points		
	Practical classes	3 ECTS credit points		
ECTS credit points of the module	9 ECTS credit points			
Credit hours		Contact hours per week (total)	Working hours in self-study	Total
	Lecture	4 hours (60 hours)	120 hours	180 hours
	Practical classes	2 hours (30 hours)	60 hours	90 hours
	Total	6 hours (90 hours)	180 hours	270 hours
Period	1 semester			
Frequency	Every summer term			
Record of study				
Prerequisites for the assessment	Successful participation at the practical classes and exercises are prerequisites for the final assessment.			
Assessment methods	Written examination (90 or 120 min) or oral examination (30 min) or other assessment method (announced at the beginning of the course)			
Requirements of the assessment	The assessment covers the learning outcomes of the entire module.			

Identifier	INF-INF-SYS-9-B			
Title of the module	**Operating System Construction**			
Intended learning outcomes	A deep understanding of concurrent processes in operating systems and of the interface between the system software and computer hardware.			
Topics	The course teaches the concepts and foundations that are required to construct an operating system. That knowledge is applied in practical classes by developing a simple PC operating system from scratch in small working groups. To do this, the students need to understand the organization and functionality of PC hardware, which is taught in the course as well. This includes the programming model of the Intel®64 architecture, contemporary PC bus systems, and multiprocessor interrupt handling. At the same time, the course recapitulates the foundations of operating systems, such as interrupts, synchronization and scheduling.			
Teaching and learning methods separated by ECTS credit points	Lecture	3 ECTS credit points		
	Practical classes	6 ECTS credit points		
ECTS credit points of the module	9 ECTS credit points			
Credit hours		Contact hours per week (total)	Working hours in self-study	Total
	Lecture	2 hours (30 hours)	60 hours	90 hours
	Practical classes	4 hours (60 hours)	120 hours	180 hours
	Total	6 hours (90 hours)	180 hours	270 hours
Period	1 semester			
Frequency	Every summer term			
Record of study				
Prerequisites for the assessment	Successful participation at the practical classes and exercises are prerequisites for the final assessment.			
Assessment methods	Written examination (90 or 120 min) or oral examination (30 min) or other assessment method (announced at the beginning of the course)			
Requirements of the assessment	The assessment covers the learning outcomes of the entire module.			

Identifier	INF-INF-SYS-6-S			
Title of the module	**IT and Network Security**			
Intended learning outcomes	Knowledge of basic concepts in IT and network security. This includes risks and vulnerabilities of current operating systems and computer networks, approaches to increase the level of security, countermeasures and reactive security.			
Topics	Threads and attacks, organizational and legal aspects, technologies such as firewalls, IDS, security protocols, hash functions, certificates, and privacy.			
Teaching and learning methods separated by ECTS credit points	Lecture	3 ECTS credit points		
	Practical classes	3 ECTS credit points		
ECTS credit points of the module	6 ECTS credit points			
Credit hours		Contact hours per week (total)	Working hours in self-study	Total
	Lecture	2 hours (30 hours)	60 hours	90 hours
	Practical classes	2 hours (30 hours)	60 hours	90 hours
	Total	4 hours (60 hours)	120 hours	180 hours
Period	1 semester			
Frequency	Every winter term			
Record of study				
Prerequisites for the assessment	Successful participation at the practical classes and exercises are prerequisites for the final assessment.			
Assessment methods	Written examination (90 or 120 min) or oral examination (30 min) or other assessment method (announced at the beginning of the course)			
Requirements of the assessment	The assessment covers the learning outcomes of the entire module.			

Identifier	INF-INF-SYS-9-S			
Title of the module	**IT and Network Security**			
Intended learning outcomes	Knowledge of basic concepts in IT and network security. This includes risks and vulnerabilities of current operating systems and computer networks, approaches to increase the level of security, countermeasures and reactive security.			
Topics	Threads and attacks, organizational and legal aspects, technologies such as firewalls, IDS, security protocols, hash functions, certificates, and privacy.			
Teaching and learning methods separated by ECTS credit points	Lecture	4.5 ECTS credit points		
	Practical classes	4.5 ECTS credit points		
ECTS credit points of the module	9 ECTS credit points			
Credit hours		Contact hours per week (total)	Working hours in self-study	Total
	Lecture	3 hours (45 hours)	90 hours	135 hours
	Practical classes	3 hours (45 hours)	90 hours	135 hours
	Total	6 hours (90 hours)	180 hours	270 hours
Period	1 semester			
Frequency	Every winter term			
Record of study				
Prerequisites for the assessment	Successful participation at the practical classes and exercises are prerequisites for the final assessment.			
Assessment methods	Written examination (90 or 120 min) or oral examination (30 min) or other assessment method (announced at the beginning of the course)			
Requirements of the assessment	The assessment covers the learning outcomes of the entire module.			

Identifier	INF-INF-BS1, INF-INF-BS2, or INF-ESS-BS			
Title of the module	**Computer Science Seminar**			
Intended learning outcomes	• Extending the basic knowledge in a selected topic of computer science • Experience with presentation and scientific writing • Reflection on the quality of scientific literature • Knowledge acquisition from a lecture, critical listening and reading			
Topics	Presentation of the state of the art in a selected topic, for example, based on conference proceedings and scientific journals			
Teaching and learning methods separated by ECTS credit points	Seminar	3 ECTS credit points		
ECTS credit points of the module	3 ECTS credit points			
Credit hours		Contact hours per week (total)	Working hours in self-study	Total
	Seminar	2 hours (30 hours)	60 hours	90 hours
Period	1 semester			
Frequency	Every summer and winter term			
Record of study				
Prerequisites for the assessment				
Assessment methods	Oral presentation and written seminar paper			
Requirements of the assessment	The assessment covers the learning outcomes of the entire module.			

Identifier	INF-ESS-BPG			
Title of the module	**Bachelor Project Group**			
Intended learning outcomes	• Specific learning objectives based on the topic of the project group • Experience with scientific working: addressing complex problems, presentation, documentation, and writing scientific documents • Experience with working in teams: project management, collaboration, specification of work products, and conflict management			
Topics	The topic varies with each instance of the course. In general, a project group combines the teaching and learning methods of lectures, seminars, and practical classes with a focus on theory and methodology based on a concrete problem that shall be solved.			
Teaching and learning methods separated by ECTS credit points	Project group	9 ECTS credit points		
ECTS credit points of the module	9 ECTS credit points			
Credit hours		Contact hours per week (total)	Working hours in self-study	Total
	Seminar	6 hours (90 hours)	180 hours	270 hours
Period	1 semester			
Frequency	Every summer term			
Record of study				
Prerequisites for the assessment				
Assessment methods	• Presentation • Completion of work products • Written documentation of the work and results			
Requirements of the assessment	The assessment covers the learning outcomes of the entire module.			

Identifier	CS-BP-NI			
Title of the module	**Machine Learning**			
Intended learning outcomes	Knowledge in the areas of unsupervised, monitored and reinforcement learning and its application; references to neuroscience			
Topics	Being a mainly academic topic about 20 years ago, machine learning has become a discipline of major impact on both science and engineering by today. This course introduces the basics of machine learning and data mining. Major topics are concept learning, decision trees, problems of data in high dimensional representations, clustering algorithms, linear and nonlinear dimension reduction, basic artificial neural networks (e.g., multilayer perceptrons, RBF networks, self-organizing maps), classification methods, reinforcement learning, modeling uncertainty, and temporal probability models.			
Teaching and learning methods separated by ECTS credit points	Lecture	8 ECTS credit points		
	Practical classes	4 ECTS credit points		
ECTS credit points of the module	12 ECTS credit points			
Credit hours		Contact hours per week (total)	Working hours in self-study	Total
	Lecture	4 hours (60 hours)	120 hours	180 hours
	Practical classes	2 hours (30 hours)	60 hours	90 hours
	Total	4 hours (90 hours)	180 hours	270 hours
Period	1 semester			
Frequency	Every summer term			
Record of study				
Prerequisites for the assessment	Successful participation at the practical classes and exercises are prerequisites for the final assessment.			
Assessment methods	Written examination			
Requirements of the assessment	The assessment covers the learning outcomes of the entire module.			

Identifier	CS-BP-NI			
Title of the module	**Neuroinformatics**			
Intended learning outcomes	Knowledge in the areas of statistical modeling, model validation, model selection, and models of neural information processing			
Topics	In this lecture, we will discuss cutting edge approaches from the field of neuroinformatics. The aim of the lecture is to get the students familiar with the concept of modeling and abstracting data, and the up to date knowledge about computational processes in the brain. After a short introduction that covers probability theory, and linear models for regression and classification, we will start a journey through the fields of graphical models and liquid computing. In the last part of the lecture we will conclude with an outlook to self-organization with the purpose to optimize information processing in complex systems like the brain.			
Teaching and learning methods separated by ECTS credit points	Lecture	8 ECTS credit points		
	Practical classes	4 ECTS credit points		
ECTS credit points of the module	12 ECTS credit points			
Credit hours		Contact hours per week (total)	Working hours in self-study	Total
	Lecture	4 hours (60 hours)	120 hours	180 hours
	Practical classes	2 hours (30 hours)	60 hours	90 hours
	Total	4 hours (90 hours)	180 hours	270 hours
Period	1 semester			
Frequency	Every winter term			
Record of study				
Prerequisites for the assessment	Successful participation at the practical classes and exercises are prerequisites for the final assessment.			
Assessment methods	Written examination			
Requirements of the assessment	The assessment covers the learning outcomes of the entire module.			

Identifier	CS-BWP-INF			
Title of the module	**Computer Vision**			
Intended learning outcomes	Both the rapid growth of image and video data and new applications such as robotics require automated image processing. This course introduces the basic concepts of artificial vision.			
Topics	Image acquisition and representation; mathematical background; basic point operations; linear and nonlinear filtering; morphological pattern recognition; color (perceptual aspects and technical representation); gray-, color- and texture-segmentation; image reconstruction and enhancement; object recognition; compression; applications (e.g., image search in databases). A focus is on object recognition, where topics range from simple edge based methods and template matching over traditional approaches like PCA over Boosting, SIFT and SURF to (deep) neural networks.			
Teaching and learning methods separated by ECTS credit points	Lecture	8 ECTS credit points		
	Practical classes	4 ECTS credit points		
ECTS credit points of the module	12 ECTS credit points			
Credit hours		Contact hours per week (total)	Working hours in self-study	Total
	Lecture	4 hours (60 hours)	120 hours	180 hours
	Practical classes	2 hours (30 hours)	60 hours	90 hours
	Total	4 hours (90 hours)	180 hours	270 hours
Period	1 semester			
Frequency	Every winter term			
Record of study				
Prerequisites for the assessment	Successful participation at the practical classes and exercises are prerequisites for the final assessment.			
Assessment methods	Written examination			
Requirements of the assessment	The assessment covers the learning outcomes of the entire module.			

Identifier	INF-INF-KI-6-M			
Title of the module	**Design of Microelectronic Systems**			
Intended learning outcomes	The course covers the design and testing of system-on-chip architectures based on hardware description languages. After attending the course, students shall be able to describe complex microelectronic systems on different levels of abstraction and to select suitable modeling methods for the simulation and synthesis of circuits in a problem-oriented way. The discussed models are used for circuit specification, simulation and synthesis in order to independently develop simple microelectronic circuits.			
Topics	• Introduction to the different levels of abstraction in microelectronic system design • Characterization of target architectures for microelectronic circuits • Architectural concepts and their description on register transfer level • Design automation • Scaling to future technologies • On-chip communication systems and integrated test facilities			
Teaching and learning methods separated by ECTS credit points	Lecture	3 ECTS credit points		
	Practical classes	3 ECTS credit points		
ECTS credit points of the module	6 ECTS credit points			
Credit hours		Contact hours per week (total)	Working hours in self-study	Total
	Lecture	2 hours (30 hours)	60 hours	90 hours
	Practical classes	2 hours (30 hours)	60 hours	90 hours
	Total	4 hours (60 hours)	120 hours	180 hours
Period	1 semester			
Frequency	Every summer term			
Record of study				
Prerequisites for the assessment	Successful participation at the practical classes and exercises are prerequisites for the final assessment.			
Assessment methods	Written examination (90 or 120 min) or oral examination (30 min) or other assessment method (announced at the beginning of the course)			
Requirements of the assessment	The assessment covers the learning outcomes of the entire module.			

Identifier	INF-INF-ALG-6-X			
Title of the module	**Approximation Algorithms**			
Intended learning outcomes	Overview of different approximation classes and types, knowledge of different algorithmic approximation techniques, knowledge of important algorithms, knowledge of classical optimization problems			
Topics				
Teaching and learning methods separated by ECTS credit points	Lecture	3 ECTS credit points		
	Practical classes	3 ECTS credit points		
ECTS credit points of the module	6 ECTS credit points			
Credit hours		Contact hours per week (total)	Working hours in self-study	Total
	Lecture	2 hours (30 hours)	60 hours	90 hours
	Practical classes	2 hours (30 hours)	60 hours	90 hours
	Total	4 hours (60 hours)	120 hours	180 hours
Period	1 semester			
Frequency	Every winter term			
Record of study				
Prerequisites for the assessment	Successful participation at the practical classes and exercises are prerequisites for the final assessment.			
Assessment methods	Written examination (90 or 120 min) or oral examination (30 min) or other assessment method (announced at the beginning of the course)			
Requirements of the assessment	The assessment covers the learning outcomes of the entire module.			

Identifier	INF-INF-SK-6-W			
Title of the module	**Web Technologies**			
Intended learning outcomes	Basic understanding of current client- and server-side technologies required for the implementation of web applications; being able to apply this basic understanding to exemplary questions of limited complexity using a selected technology stack; being able to systematically apply quality assurance measures for web applications; being able to recognize and consider security issues of web applications			
Topics	HTTP, HTML, CSS, Java script, framework-based development of interactive application with and without database connection, AJAX, RSS, web services			
Teaching and learning methods separated by ECTS credit points	Lecture	3 ECTS credit points		
	Practical classes	3 ECTS credit points		
ECTS credit points of the module	6 ECTS credit points			
Credit hours		Contact hours per week (total)	Working hours in self-study	Total
	Lecture	2 hours (30 hours)	60 hours	90 hours
	Practical classes	2 hours (30 hours)	60 hours	90 hours
	Total	4 hours (60 hours)	120 hours	180 hours
Period	1 semester			
Frequency				
Record of study				
Prerequisites for the assessment	Successful participation at the practical classes and exercises are prerequisites for the final assessment.			
Assessment methods	Written examination (90 or 120 min) or oral examination (30 min) or other assessment method (announced at the beginning of the course)			
Requirements of the assessment	The assessment covers the learning outcomes of the entire module.			