MODULE HANDBOOK

Information Technology

Master (M.Eng.)
Fb 2: Informatik und Ingenieurwissenschaften – Computer Science and Engineering

Fachhochschule Frankfurt am Main
- University of Applied Sciences
Nibelungenplatz 1

1. General qualification profile of the study programme

On successful completion of the Master-Program “Information Technology” the students acquired a post graduate qualification to be technical specialists and technical managers for positions in the information technology industry. The students gathered profound knowledge in advanced mathematics, information and communication, improved and enhanced their knowledge in advanced theoretical methods of engineering and specialized their applied engineering knowledge, which serve as a base for further innovative approaches.

The Graduates are competent and qualified to think in a multi- and interdisciplinary way when applying laws and principles of information technology in order to solve challenging and complex technical problems, particularly in reference to the development of new technologies, products, and services. They possess skills and experiences in digital communication systems, optical and microwave systems or in intelligent systems, intelligent sensors and pattern recognition.

Specific courses like "International Project Management and Business Administration" the "Project Course" enable the Students to be qualified in the design of projects, processes, the mastering of change management and the creation of new strategic approaches. They will be able to contribute for the enhancement of technical knowledge and lead and mange teams and projects. They are able to master complex and unpredictable problems with innovative solutions. They are able to apply modern project management and business administration methods.

By experiencing a variety of situations in laboratories, during specific project work the students acquire specific skills in innovative engineering methods and strategies and will be reflective practitioner.

The students identify and reflect the professional requirements and prepared for lifelong learning. They are able to use presentation skills, apply self and project management, gather information suited that is suited for academic discussion, and describe requirements, problems and results in English language. Their disposal key competences in technical English, in social interaction (team work, project work) and in professional presentation and communication.

The prospective engineers are qualified for positions in academia, public administration and industry e.g. technical specialists or technical managers or for pursuing a PhD. They acquired and applied different methods that allow them to work in research and development of integrated product and

service concepts in the area of information technology. Career opportunities include research and development of technical systems and the management of such projects. They qualified as technical specialists and technical managers in the information technology industry

2. Recommended course of studies

1st semester	Vector Analysis	Stochastic Signals and Systems	Methods, Systems and Networks for Digital Communication	Circuit Design for Communication Systems	Software Engineering	International Project Management and Business Administration
2nd semester	Digital Baseband Transmission and Modulation Methods	Distributed Systems and Computer Networks	Digital Switching and Routing	Field Theory for Optical and Microwave Systems	Image Processing and Identification of Dynamic Systems	Optional Technical Subject 1
3rd semester	Mobile Computing	Optional Technical Subject 2	Automation Laboratory	Computational Intelligence	Autonomous Intelligent Systems	Project
4th semester	Master Thesis with Colloquium					

3. ECTS/Workload overview

Sem.	Module title	ECTS	Duration [Sem]	Teaching method	Examination method	Language	Contact hours per week
1	M1 Vector Analysis	5	1	Lecture, Exercise	Written examination 90 minutes	English	4
1	M2 Stochastic Signals and Systems	5	1	Lecture, Exercise	Written examination 90 minutes	English	4
1	M3 Methods, Systems and Networks for Digital Communication	5	1	Lecture, Exercise	Written examination 90 minutes	English	4
1	M4 Circuit Design for Communication Systems	5	1	Lecture, Exercise	Written examination 90 minutes	English	4
1	M5 Software Engineering	5	1	Lecture, Project	Project (duration 5 months)	English	3
2	M6 Digital Baseband Transmission and Modulation Methods	5	1	Lecture, Exercise	Written examination 90 minutes	English	4
2	M7 Distributed Systems and Computer Networks	5	1	Seminar lecture	Written examination 90 minutes	English	4
3	M8 Mobile Computing	5	1	Lecture, Project	Written project documentation and presentation (15-20 minutes)	English	3
2	M9 Digital Switching an Routing	5	1	Lecture, Labor	Written examination 90 minutes	English	3
2	M10 Field Theory for Optical and Microwave Systems	5	1	Lecture, Exercise	Written examination 90 minutes	English	4
3	M11.1 Engineering of Optical Systems	5	1	Lecture, Project	Written project documentation and presentation (15-20 minutes)	English	3
3	M11.2 Engineering of Microwave Systems	5	1	Lecture, Project	Written project documentation and presentation (15-20 minutes)	English	3
3	M11.3 Digital Control System Design	5	1	Lecture, Laboratory	Written examination 90 minutes	English	3
2	M12 Image Processing and Identification of Dynamic Systems	5	1	Lecture, Exercise	Written examination 90 minutes	English	5
3	M13 Automation Laboratory	5	1	Project	Project (duration 5 months)	English	1
3	M14 Computational Intelligence	5	1	Seminar lecture	Written seminar assignment (duration 6 weeks) and oral presentation	English	4

Sem.	Module title	ECTS	Duration [Sem]	Teaching method	Examination method	Language	Contact hours per week
					(45-60 minutes)		
3	M15 Autonomous Intelligent Systems	5	1	Lecture, Project	Project (duration 5 months)	English	3
2	M16.1 Numerical Field Theory	5	1	Seminar lecture	Colloquium with presentation	English	3
2	M16.2 Modern Control Theory	5	1	Lecture	Written examination 90 minutes	English	3
2	M16.3 Wireless System Design	5	1	Lecture, Laboratory	Written examination 90 minutes	English	3
1	M17 International Project Management and Business Administration	5	1	Lecture	Written examination 90 minutes	English	4
3	M18 Project	5	1	Project	Project (duration 5 months)	English	2
4	M19 Master Thesis with Colloquium	30	1	Self-study project	Master Thesis, Colloquium	English	6

Module Overview for the Master course in Information Technology

	1st semester	2nd semester	3rd semester	4th semester
Module 1: Vector Analysis	5/4			
Module 2: Stochastic Signals and Systems	5/4			
Module 3: Methods, Systems and Networks for Digital Communication	5/4			
Module 4: Circuit Design for Communication Systems	5/4			
Module 5: Software Engineering	5/3			
Module 6: Digital Baseband Transmission and Modulation Methods		5/4		
Module 7: Distributed Systems and Computer Networks		5/4		
Module 8: Mobile Computing			5/3	
Module 9: Digital Switching and Routing		5/3		
Module 10: Field Theory for Optical and Microwave Communication Systems		5/4		
Module 11: Optional Technical Subject			5/3	
Module 12: Image Processing and Identification of Dynamic Systems		5/5		
Module 13: Automation Laboratory			5/1	
Module 14: Computational Intelligence			5/4	
Module 15: Autonomous Intelligent Systems			5/3	
Module 16: Optional Technical Subject		5/3		
Module 17: International Project Management and Business Administration	5/4			
Module 18: Project			5/2	
Module 19: Master Thesis with Colloquium				30/6
Sum ECTS/hours per week	**30/23**	**30/23**	**30/16**	**30/6**

4. Module description

Module description of Module 1 **Vector Analysis**

Study programme	Information technology
Module title	Vector Analysis
Module number	1
Module code	
Units	Lectures combined with exercises in Vector Analysis
Level	Advanced level course
Applicability of the module to other study programmes	
Duration of the module	1 semester
Status of the module	Compulsory module
Recommended semester during the study programme	1
Credit points (Cp) of the module	5
Prerequisites for module participation	None
Recommended contents of previous modules	None
Prerequisites for module examination	None
Module examination	Written examination, 90 minutes, English
Intended learning outcomes /acquired competences of the module	By the end of the course, students are able to: Calculate scalar, vector and tensor products. Find the vector equations of lines and planes Understand the parametric equations of curves and surfaces. Find the gradient of a function. Find the divergence and curl of a vector field Use the gradient operator to calculate the directional derivative of a function. Understand the various integral theorems relating line, surface and volume integrals. Transfer mathematical knowledge to describe engineering problems.
Contents of the module	Lectures combined with exercises in Vector Analysis
Teaching methods of the module	Lectures combined with exercises
Total workload	150 h
Language of the module	English
Frequency of the module	Annually
Module coordination	Hannemann
Further information	Not applicable

Unit description

Unit description 1 of Module 1 **Lectures combined with exercises in Vector Analysis**

Name of the unit	Lectures combined with exercises in Vector Analysis
Code	Unit 1 of Module 1
Corresponding module	Vector Analysis
Lecturer	Hannemann
Contents of the unit	Vector and tensor algebra: superposition, scalar and vector product, multiple products, tensor product, definition of a tensor, tensor operations Fields: scalar, vector and tensor fields, curves and planes, coordinate transformation Derivatives: partial derivatives, gradient, divergence, curl, Laplace operator, interpretation of Maxwell equations Integration: work, potential, line integral, surface integral, flux, volume integrals, integral theorems: Gauß, Stokes and Green, applications exercises and assignments
Teaching methods	Lectures combined with exercises
Contact hours per week	4
Total workload of the unit (h)	150
Total time of contact hours (h)	60, thereof exercises: 15
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	0
Total time of self-study (h)	90
Language of the unit	English
Recommended reading	Marsden, J.E.; Tromba, A.J.: Vector Calculus; W. H. Freemann and Company, New York Strassacker, G.: Rotation, Divergenz und das Drumherum; B. G. Teubner, Stuttgart Additional up-to-date reading information will be provided at the beginning of the lecture.
Type and form of assessment	See module description
Grading of the assessment	Graded
Further information	Not applicable

Module description

Module description of Module 2 **Stochastic Signals and Systems**

Study programme	Information technology
Module title	Stochastic Signals and Systems
Module number	2
Module code	
Units	Lectures combined with exercises in Stochastic Signals and Systems
Level	Advanced level course
Applicability of the module to other study programmes	
Duration of the module	1 semester
Status of the module	Compulsory module
Recommended semester during the study programme	1
Credit points (Cp) of the module	5
Prerequisites for module participation	None
Recommended contents of previous modules	None
Prerequisites for module examination	None
Module examination	Written examination, 90 minutes, English
Intended learning outcomes /acquired competences of the module	After the first part of the course the students have a thorough understanding of the fundamentals of random processes and according to this all students who started with different prerequisites are on the same level. The students are able to describe stochastic processes in information and communication systems adequately. The students are familiar with important estimation methods, and they are able to choose appropriate estimation methods for parameter estimation on stochastic signals. The students master the theory of non-recursive and recursive optimum systems. The students are able to apply them to information and communication systems. The students are able to design recursive estimators and predictors. The students are familiar with coloured process noise and correlated measurement noise. The students are able design extended Kalman filters. Students have gathered sufficient proficiency in Matlab and they are able to apply the acquired skills and knowledge in this Module to a wide range of disciplines.
Contents of the module	Lectures and exercises in Stochastic Signals and Systems

Teaching methods of the module	Lectures and exercises
Total workload	150 h
Language of the module	English
Frequency of the module	Annually
Module coordination	Pech
Further information	Not applicable

Unit description

Unit description 1 of Module 2 **Lectures in Stochastic Signals and Systems**

Name of the unit	Lectures in Stochastic Signals and Systems
Code	Unit 1 of Module 2
Corresponding module	Stochastic Signals and Systems
Lecturer	Pech
Contents of the unit	Fundamentals of random variables and random processes. Fundamentals of linear and nonlinear systems. Fundamentals of estimation and prediction. Maximum likelihood estimation and other estimation methods and their properties. Optimum systems. Optimum non-recursive estimation. Wiener-filtering. Optimum recursive estimation. Kalman filter. Coloured process noise, correlated measurement noise. Nonlinear minimum variance estimation. Extended Kalman filter. Exercises using MATLAB.
Teaching methods	Lectures
Contact hours per week	4
Total workload of the unit (h)	125
Total time of contact hours (h)	60
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	0
Total time of self-study (h)	65
Language of the unit	English
Recommended reading	Davenport, Root: An Introduction to the Theory of Random Signals and Noise, Wiley 1989 Additional up-to-date reading information will be provided at the beginning of the lecture.
Type and form of assessment	See module description
Grading of the assessment	Graded
Further information	Not applicable

Unit description

Unit description 2 of Module 2 **Exercises in Stochastic Signals and Systems**

Name of the unit	Exercises in Stochastic Signals and Systems
Code	Unit 2 of Module 2
Corresponding module	Stochastic Signals and Systems
Lecturer	Pech
Contents of the unit	Exercises exemplifying the content of the lectures, exercises using MATLAB
Teaching methods	Exercises
Contact hours per week	1
Total workload of the unit (h)	25
Total time of contact hours (h)	15
Total time of examination incl. preparation (h)	0
Total time of practical training (h)	0
Total time of self-study (h)	10
Language of the unit	English
Recommended reading	Davenport, Root: An Introduction to the Theory of Random Signals and Noise, Wiley 1989 Additional up-to-date reading information will be provided at the beginning of the lecture.
Type and form of assessment	Not applicable
Grading of the assessment	Not applicable
Further information	Not applicable

Module description

Module description of Module 3 **Methods, Systems and Networks for Digital Communication**

Study programme	Information Technology
Module title	Methods, Systems and Networks for Digital Communication
Module number	3
Module code	
Units	Lectures combined with exercises in Methods, Systems and Networks for Digital Communication
Level	Advanced level course
Applicability of the module to other study programmes	
Duration of the module	1 semester
Status of the module	Compulsory module
Recommended semester during the study programme	1
Credit points (Cp) of the module	5
Prerequisites for module participation	None
Recommended contents of previous modules	None
Prerequisites for module examination	None
Module examination	Written examination, 90 minutes, English
Intended learning outcomes /acquired competences of the module	Students from different countries and different backgrounds have harmonized their knowledge and acquired comparable skills in the fundamentals of telecommunication and network technologies. They will have substantial knowledge of the functionalities, network nodes and architectures of modern telecommunication systems and networks and know details about the essential communication protocols. On successful completion of the subject the students are able to: - analyse different network technologies and protocols - specify network nodes and architectures - recognize and analyse relationships in modern communication networks and to highlight optimization (?) opportunities. They are able to do scientific research and present the accumulated knowledge to other students.
Contents of the module	Lectures combined with exercises in Methods, Systems and Networks for Digital Communication
Teaching methods of the module	Lectures combined with exercises
Total workload	150 h
Language of the module	English
Frequency of the module	Annually
Module coordination	Trick

Further information	Not applicable

Unit description

Unit description 1 of Module 3 **Lectures combined with exercises in Methods, Systems and Networks for Digital Communication**

Name of the unit	Lectures combined with exercises in Methods, Systems and Networks for Digital Communication
Code	Unit 1 of Module 3
Corresponding module	Methods, Systems and Networks for Digital Communication
Lecturer	Trick
Contents of the unit	Overview: telecommunications technologies, signals, protocols, services, and networks Telecommunication Networks in detail: general architecture of a telecommunication network, ISDN, LAN, Internet, GSM and UMTS TCP/IP: Ethernet, IP, TCP, HTTP Next Generation Networks, Voice over IP and SIP: real-time communication in IP networks, SIP and SDP, SIP network elements and network architectures
Teaching methods	Lectures combined with exercises
Contact hours per week	4
Total workload of the unit (h)	150
Total time of contact hours (h)	60, thereof exercises: 15
Total time of examination incl. preparation (h)	30
Total time of practical training (h)	0
Total time of self-study (h)	60
Language of the unit	English
Recommended reading	Trick, Ulrich; Weber, Frank: SIP, TCP/IP und Telekommunikationsnetze, 4. Auflage, Oldenbourg, 2009 Stallings, William: Data and Computer Communications, Pearson Education, 2010 Tanenbaum, Andrew S.; Wetherall, David: Computer Networks, Prentice Hall International, 2010 Poikselkä, Miikka; Mayer, Georg: The IMS: IP Multimedia Concepts and Services, John Wiley, 2009 Johnston, Alan B.: SIP: Understanding the Session Initiation Protocol, Artech House, 2009 Additional up-to-date reading information will be provided at the beginning of the lecture.
Type and form of assessment	See module description
Grading of the assessment	Graded
Further information	Not applicable

Module description of Module 4 **Circuit Design for Communication Systems**

Study programme	Information technology
Module title	Circuit Design for Communication Systems
Module number	4
Module code	
Units	Lectures combined with exercises in Circuit Design for Communication Systems
Level	Advanced level course
Applicability of the module to other study programmes	
Duration of the module	1 semester
Status of the module	Compulsory module
Recommended semester during the study programme	1
Credit points (Cp) of the module	5
Prerequisites for module participation	None
Recommended contents of previous modules	None
Prerequisites for module examination	None
Module examination	Written examination, 90 minutes, English
Intended learning outcomes /acquired competences of the module .	By the end of the course, students are able - to understand the underlying technology of communication systems. - to compare technical solutions for their merits in terms of functional and non-functional requirements, within the domain of communication systems. - to select and apply suitable techniques of analysis and design to develop a good technical solution. - to exercise professional responsibility in designing and assessing the effectiveness of solutions developed.
Contents of the module	Lectures combined with exercises in Circuit Design for Communication Systems
Teaching methods of the module	Lectures and exercises
Total workload	150 h
Language of the module	English
Frequency of the module	Annually
Module coordination	Zimmer
Further information	Not applicable

Unit description

Unit description 1 of Module 4 **Lectures combined with exercises in Circuit Design for Communication Systems**

Name of the unit	Lectures combined with exercises Circuit Design for Communication Systems
Code	Unit 1 of Module 4
Corresponding module	Circuit Design for Communication Systems
Lecturer	Zimmer
Contents of the unit	Overview of communication systems, standards, frequencies and circuit technologies; transmission line theory and scattering parameters; amplifier design, low-noise amplifier, power amplifier; mixer design, semiconductor devices for mixers, diode mixers, FET-mixers; frequency synthesizer design, voltage controlled oscillators, phase lock-loop design, implementations of PLLs; wireless communication applications, transceiver requirements, amplifier, mixer, filter and synthesizer requirements; examples of radio frequency ICs
Teaching methods	Lectures combined with exercises
Contact hours per week	4
Total workload of the unit (h)	150
Total time of contact hours (h)	60, thereof exercises: 15
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	0
Total time of self-study (h)	90
Language of the unit	English
Recommended reading	Medley M.,W.: Microwave and RF Circuits, Analysis, Synthesis and Design; Artech House, Boston Robertson, I.D.; Lucyszn, S.: RFIC and MMIC design and technology Institution of Electrical Engineers, London Additional up-to-date reading information will be provided at the beginning of the lecture.
Type and form of assessment	See module description
Grading of the assessment	Graded
Further information	Not applicable

Module description

Module description of Module 5 **Software Engineering**

Study programme	Information technology
Module title	Software Engineering
Module number	1
Module code	
Units	Lectures in Software Engineering Project in Software Engineering
Level	Advanced level course
Applicability of the module to other study programmes	
Duration of the module	1 semester
Status of the module	Compulsory module
Recommended semester during the study programme	1
Credit points (Cp) of the module	5
Prerequisites for module participation	None
Recommended contents of previous modules	None
Prerequisites for module examination	None
Module examination	Project, processing time one semester
Intended learning outcomes /acquired competences of the module .	In the course the students will be familiar with software engineering techniques and archive the ability and perform and manage software projects in teams. On successful completion of the subject the students are able to: • Plan and analyze the entire software lifecycle • Gather appropriate information needed to perform a requirements specification • Work out requirements specification documents • Design and develop software o Plan and create suitable software tests, create appropriate test data and run a software integration test, a system test or a component test • Manage and lead a software prototyping process as well as a conventional software development process • Apply quality management techniques to a software development process They are able to organize and manage technical projects and familiar with teamwork. Furthermore they are able to present and discuss the accumulated knowledge, strategy and solution to professional audiences and transfer the acquired skills to other disciplines.

Contents of the module	Lectures in Software Engineering Project in Software Engineering
Teaching methods of the module	Lectures and exercises
Total workload	150 h
Language of the module	English
Frequency of the module	Annually
Module coordination	Pech
Further information	Not applicable

Unit description

Unit description 1 of Module 5 **Lectures in Software Engineering**

Name of the unit	Lectures in Software Engineering
Code	Unit 1 of Module 5
Corresponding module	Software Engineering
Lecturer	Pech, Nauth
Contents of the unit	This course covers the entire software development life-cycle including planning, requirements analysis, requirements specification, and design. Emphasis is placed on advanced topics including prototyping, verification and validation, testing, and quality management.
Teaching methods	Lecture
Contact hours per week	2
Total workload of the unit (h)	45
Total time of contact hours (h)	30
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	0
Total time of self-study (h)	15
Language of the unit	English
Recommended reading	Sommerville I.: Software Engineering, Addison-Wesley Longman 2011 Alhir, S.S.: Guide to Applying the UML, Springer 2002 Additional up-to-date reading information will be provided at the beginning of the lecture.
Type and form of assessment	Not applicable
Grading of the assessment	Not applicable
Further information	Not applicable

Unit description

Unit description 2 of Module 5 **Project in Software Engineering**

Name of the unit	Project in Software Engineering
Code	Unit 2 of Module 5
Corresponding module	Software Engineering
Lecturer	Pech, Nauth
Contents of the unit	Individual Software Engineering Project
Teaching methods	Project
Contact hours per week	2
Total workload of the unit (h)	105
Total time of contact hours (h)	15
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	The self-study and contact time (see above/below) include the practical training.
Total time of self-study (h)	90
Language of the unit	English
Recommended reading	Up-to-date reading information will be provided at the beginning of the project.
Type and form of assessment	See module description
Grading of the assessment	Graded
Further information	Not applicable

Module description

Module description of Module 6 **Digital Baseband Transmission and Modulation Methods**

Study programme	Information Technology
Module title	Digital Baseband Transmission and Modulation Methods
Module number	6
Module code	
Units	Lectures combined with exercises in Digital Baseband Transmission and Modulation Methods
Level	Advanced level course
Applicability of the module to other study programmes	
Duration of the module	1 semester
Status of the module	Compulsory module
Recommended semester during the study programme	2
Credit points (Cp) of the module	5
Prerequisites for module participation	None
Recommended contents of previous modules	None
Prerequisites for module examination	None
Module examination	Written examination 90 minutes, English
Intended learning outcomes /acquired competences of the module .	On successful completion of the subject the student will have a thorough understanding of the methods of digital baseband transmission and modulation techniques for transmission systems. He will be able to specify the system architecture, the hardware and the software structure of transmission nodes.
Contents of the module	Lectures combined with exercises in Digital Baseband Transmission and Modulation Methods
Teaching methods of the module	Lectures combined with exercises
Total workload	150 h
Language of the module	English
Frequency of the module	Annually
Module coordination	Kastell

Unit description

Unit description 1 of Module 6 **Lectures combined with exercises in Digital Baseband Transmission and Modulation Methods**

Name of the unit	Lectures combined with exercises in Digital Baseband Transmission and Modulation Methods
Code	Unit 1 of Module 6
Corresponding module	Digital Baseband Transmission and Modulation Methods
Lecturer	Kastell
Contents of the unit	Digital baseband transmission, pulse shaping, eye -d coding; modulation: amplitude shift keying (ASK), frequency shift keying (FSK), phase shift keying (PSK), continuous phase frequency shift keying (CPFSKK), amplitude phase shift keying (APK), continuous phase modulation (CPM), xDSL, basics of optical transmission
Teaching methods	Lectures with combined exercises
Contact hours per week	4
Total workload of the unit (h)	150
Total time of contact hours (h)	60, thereof exercises: 15
Total time of examination incl. preparation (h)	The private study ((see below) includes the preparation for the module examination
Total time of practical training (h)	0
Total time of self-study (h)	90
Language of the unit	English
Recommended reading	Lecture notes, additional up-to-date reading information will be provided at the beginning of the lecture.
Type and form of assessment	See module description
Grading of the assessment	Graded
Further information	Not applicable

Module description

Module description of Module 7 **Distributed Systems and Computer Networks**

Study programme	Information technology
Module title	Distributed Systems and Computer Networks
Module number	7
Module code	
Units	Seminar in Distributed Systems and Computer Networks
Level	Advanced level course
Applicability of the module to other study programmes	
Duration of the module	1 semester
Status of the module	Compulsory module
Recommended semester during the study programme	2
Credit points (Cp) of the module	5
Prerequisites for module participation	None
Recommended contents of previous modules	Module 5
Prerequisites for module examination	None
Module examination	Written examination, 90 minutes, English
Intended learning outcomes /acquired competences of the module .	On successful completion of the subject the Student achieves the ability to analyze, design, validate and operate distributed systems and computer networks
Contents of the module	Distributed Systems and Computer Networks
Teaching methods of the module	Seminar
Total workload	150 h
Language of the module	English
Frequency of the module	Annually
Module coordination	Pech
Further information	Not applicable

Unit description

Unit description 1 of Module 7 **Seminar in Distributed Systems and Computer Networks**

Name of the unit	Seminar in Distributed Systems and Computer Networks
Code	Unit 1 of Module 7
Corresponding module	Distributed Systems and Computer Networks
Lecturer	Pech
Contents of the unit	Architectures, processes, communication, synchronization, consistency, fault tolerance, security, case studies of distributed systems
Teaching methods	Seminar
Contact hours per week	4
Total workload of the unit (h)	150
Total time of contact hours (h)	60
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	0
Total time of self-study (h)	90
Language of the unit	English
Recommended reading	Tanenbaum A.S., van Steen M.: Distributed Systems, Prentice Hall 2007 Additional up-to-date reading information will be provided at the beginning of the lecture.
Type and form of assessment	Not applicable
Grading of the assessment	Not applicable
Further information	Not applicable

Module description

Module description of Module 8 **Mobile Computing**

Study programme	Information Technology
Module title	Mobile Computing
Module number	8
Module code	
Units	Lectures in Mobile Computing Mobile Computing Project
Level	Advanced level course
Applicability of the module to other study programmes	
Duration of the module	1 semester
Status of the module	Compulsory module
Recommended semester duringthe study programme	3
Credit points (Cp) of the module	5
Prerequisites for module participation	None
Recommended contents of previous modules	Modules 5, 9, Programming Skills
Prerequisites for module examination	None
Module examination	Project result, documentation, presentation, English
Intended learning outcomes /acquired competences of the module .	On successful completion of the subject the student will have a thorough understanding of the fundamentals of Mobile Computing, types of mobility, mobility support, protocols, network architectures, and selected areas of applications. The student improves the key skills: Project work, team work, documentation, and presentation.
Contents of the module	Lectures in Mobile Computing Mobile Computing Project
Teaching methods of the module	Lectures Project
Total workload	150 h
Language of the module	English
Frequency of the module	Annually
Module coordination	Trick
Further information	Not applicable

Unit description

Unit description 1 of Module 8 Lectures in **Mobile Computing**

Name of the unit	Lectures in Mobile Computing
Code	Unit 1 of Module 8
Corresponding module	Mobile Computing
Lecturer	Trick
Contents of the unit	Introduction: Terms, types of mobility, handover, roaming, mobility support at various layers, GSM/UMTS cellular mobile networks Presentations on topics of Mobile Computing
Teaching methods	Lecture
Contact hours per week	2
Total workload of the unit (h)	45
Total time of contact hours (h)	30
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	0
Total time of self-study (h)	15
Language of the unit	English
Recommended reading	Trick, Ulrich; Weber, Frank: SIP, TCP/IP und Telekommunikationsnetze, Oldenbourg, 2009 Roth, Jörg: Mobile Computing, dpunkt, 2005 Kamal, Raj: Mobile Computing, Oxford Univ Pr, 2008 Additional up-to-date reading information will be provided at the beginning of the lecture.
Type and form of assessment	Not applicable
Grading of the assessment	Not applicable
Further information	Not applicable

Unit description

Unit description 2 of Module 8 **Mobile Computing Project**

Name of the unit	Mobile Computing Project
Code	Unit 2 of Module 8
Corresponding module	Mobile Computing
Lecturer	Trick
Contents of the unit	Individual Mobile Computing Project
Teaching methods	Project
Contact hours per week	1
Total workload of the unit (h)	105
Total time of contact hours (h)	15
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	0
Total time of self-study (h)	90
Language of the unit	English
Recommended reading	Worksheets Additional up-to-date reading information will be provided at the beginning of the lecture.
Type and form of assessment	See module description
Grading of the assessment	Graded
Further information	Not applicable

Module description

Module description of Module 9 **Digital Switching and Routing**

Study programme	Information Technology
Module title	Digital Switching and Routing
Module number	9
Module code	
Units	2 h Unit 09.1 Lectures in Digital Switching and Routing 2 h Unit 09.2 Digital Switching and Routing Laboratory
Level	Advanced level course
Applicability of the module to other study programmes	
Duration of the module	1 semester
Status of the module	Compulsory module
Recommended semester during the study programme	2
Credit points (Cp) of the module	5
Prerequisites for module participation	None
Recommended contents of previous modules	Module 3
Prerequisites for module examination	Lab certificate
Module examination	Written examination, 90 minutes, English
Intended learning outcomes /acquired competences of the module .	On successful completion of the subject the student will have a thorough understanding of the development, planning and operating of switching and routing systems. He will be able to analyse, to specify and to develop protocols and network nodes for switching and routing Key skills: Identifying of correlations in complex systems, system analysis capability, system optimization, team work
Contents of the module	Lectures in Digital Switching and Routing Digital Switching and Routing Laboratory
Teaching methods of the module	Lectures combined with exercises Lab experiments
Total workload	150 h
Language of the module	English
Frequency of the module	Annually
Module coordination	Trick
Further information	Not applicable

Unit description

Unit description 1 of Module 9 **Lectures combined with exercises in Digital Switching and Routing**

Name of the unit	Lectures combined with exercises in Digital Switching and Routing
Code	Unit 1 of Module 9
Corresponding module	Digital Switching and Routing
Lecturer	Trick
Contents of the unit	Introduction: LAN, ISDN Ethernet: MAC, LLC Switch: bridge, switch, backward learning, spanning tree protocol IPv4: IPv4 header, functionality IP-Routing: IP network structure, routing, routing strategies, routing protocols QoS: over provisioning, traffic engineering, IntServ, DiffServ IPv6: IPv6 versus IPv4, IPv6 header, IPv6 addresses, ICMPv6, NDP, DHCPv6, IPv4-IPv6 migration MPLS: architecture, functionality, protocols
Teaching methods	Lectures combined with exercises
Contact hours per week	3
Total workload of the unit (h)	75
Total time of contact hours (h)	45, thereof exercises: 15
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	0
Total time of self-study (h)	30
Language of the unit	English
Recommended reading	Trick, Ulrich; Weber, Frank: SIP, TCP/IP und Telekommunikationsnetze, 4. Auflage. Oldenbourg, 2009 Stallings, William: Data and Computer Communications, Pearson Education, 2010 Tanenbaum, Andrew S.; Wetherall, David: Computer Networks, Prentice Hall International, 2010 Additional up-to-date reading information will be provided at the beginning of the lecture.
Type and form of assessment	See module description
Grading of the assessment	Graded
Further information	Not applicable

Unit description

Unit description 2 of Module 9 **Digital Switching and Routing Laboratory**

Name of the unit	Digital Switching and Routing Laboratory
Code	Unit 2 of Module 9
Corresponding module	Digital Switching and Routing
Lecturer	Trick
Contents of the unit	Experiment 1: Installation, configuration and testing a SIP based VoIP infrastructure Experiment 2: Installation, configuration and testing a Linux based IP router Experiment 3: Basics of IP based communication using IPv4 and IPv6
Teaching methods	Lab experiments
Contact hours per week	1
Total workload of the unit (h)	75
Total time of contact hours (h)	15
Total time of examination incl. preparation (h)	0
Total time of practical training (h)	0
Total time of self-study (h)	60 including preparation of lab certificate
Language of the unit	English
Recommended reading	Worksheets Additional up-to-date reading information will be provided at the beginning of the lecture.
Type and form of assessment	See module description
Grading of the assessment	Passed/failed
Further information	For the laboratory a timely registration is needed, details are announced on the information board of the laboratory.

Module description

Module description of Module 10 **Field Theory for Optical and Microwave Systems**

Study programme	Information Technology
Module title	Field Theory for Optical and Microwave Systems
Module number	10
Module code	
Units	4 h Lectures and exercises in Field Theory for Optical and Microwave Systems
Level	Advanced level course
Applicability of the module to other study programmes	
Duration of the module	1 semester
Status of the module	Compulsory module
Recommended semester during the study programme	2
Credit points (Cp) of the module	5
Prerequisites for module participation	None
Recommended contents of previous modules	Higher mathematics
Prerequisites for module examination	None
Module examination	Written examination, 90 minutes, English
Intended learning outcomes /acquired competences of the module .	By the end of the course, students are able to: explain Maxwell’s Equations formulate all boundary conditions formulate and solve the wave equation of a plane wave classify different wave solutions explain the modes of rectangular and circular waveguides find solutions of a dielectric slab waveguide explain the weakly guided solutions of cylindrical optical waveguides
Contents of the module	Lectures combined with exercises in Field Theory for Optical and Microwave Systems
Teaching methods of the module	Lectures combined with exercises
Total workload	150 h
Language of the module	English
Frequency of the module	Annually
Module coordination	Zimmer
Further information	Not applicable

Unit description

Unit description 1 of Module 10 **Lectures combined with exercises in Field Theory for Optical and Microwave Systems**

Name of the unit	Lectures combined with exercises in Field Theory for Optical and Microwave Systems
Code	
Corresponding module	Field Theory for Optical and Microwave Systems
Lecturer	Zimmer
Contents of the unit	Microwave and optical Systems, Introduction, the electromagnetic spectrum, History and uses of microwave and optics, Communication systems, Radar and Lidar systems, Remote sensing systems Electromagnetic theory, Maxwell's equations, Constitutive relations, Static fields, Maxwell's equation in the frequency domain, the electromagnetic wave equation, Power in the electromagnetic wave and the Poynting vector, Boundary conditions, Plane Waves, Reflections from a conducting plane, a dielectric interface Guided Waves, Classification of wave solutions, Fields of TEM, TM and TE Modes Microwave waveguides, Microwave transmission lines, Rectangular and circular waveguide, Other waveguide types, Waveguide components Optical Waveguides, Principles of dielectric waveguides, Dielectric slab waveguide, Optical fibres, Modes in cylindrical optical waveguides, Transmission losses in optical fibres, Signal distortion due to dispersion Antennas, Purpose of antennas and types, Basic antenna properties, Radiation from apertures Moment Method
Teaching methods	Lectures combined with exercises
Contact hours per week	4
Total workload of the unit (h)	150
Total time of contact hours (h)	60, thereof exercises: 15
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	0
Total time of self-study (h)	90
Language of the unit	English
Recommended reading	Collin, R.E.: Foundations for microwave engineering, McGraw Hill, New York Olver, A. D.: Microwave and Optical Transmission, John Wiley, New York Unger, H. G.: Elektromagnetische Theorie für die Hochfrequenztechnik, Hüthig-Verlag Additional up-to-date reading information will be

	provided at the beginning of the lecture.
Type and form of assessment	See module description
Grading of the assessment	Graded
Further information	Not applicable

Module description

Module description of Module 11 Alternative 1 **Engineering of Optical Systems**

Study programme	Information Technology
Module title	Engineering of Optical Systems
Module number	11
Module code	
Units	Lectures in Engineering of Optical Systems Engineering of Optical Systems Project
Level	Advanced level course
Applicability of the module to other study programmes	
Duration of the module	1 semester
Status of the module	Elective module
Recommended semester during the study programme	3
Credit points (Cp) of the module	5
Prerequisites for module participation	None
Recommended contents of previous modules	Module 10
Prerequisites for module examination	None
Module examination	Written documentation of project result and presentation (15-20 minutes), English
Intended learning outcomes /acquired competences of the module .	Students acquire knowledge of different theoretical system architectures in the field of optics. They understand the design process and the requirements of the selected system architectures. They acquire practical knowledge to develop computer supported optical design. On successful completion of the Module the students are able to: • Calculate and measure system parameters of optical systems • Research appropriate information to perform requirements specification • Analyze and optimize optical systems • Consider the different specifications of optical systems and realize a computer supported optical systems They are able to organize a technical project and work together in a team. They are able to present and discuss the approach.
Contents of the module	Lectures in Engineering of Optical and Systems Engineering of Optical and Systems Project
Teaching methods of the module	Lectures and Project

Total workload	150 h
Language of the module	English
Frequency of the module	Annually
Module coordination	Zimmer
Further information	Not applicable

Unit description

Unit description 1 of Module 11 Alternative 1 **Lectures in Engineering of Optical Systems**

Name of the unit	Lectures in Engineering of Optical Systems
Code	
Corresponding module	Engineering of Optical Systems
Lecturer	Zimmer
Contents of the unit	Modulation and noise behaviour of semiconductor lasers and photo detectors; system architecture of different optical systems e.g. optical LANs or optical sensors; component requirements to design and build the physical layers
Teaching methods	Lecture
Contact hours per week	2
Total workload of the unit (h)	45
Total time of contact hours (h)	30
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	0
Total time of self-study (h)	15
Language of the unit	English
Recommended reading	Petermann, K.: Laser Diode Modulation and Noise, Kluwer Academic Publishers, London Olver, A. D.: Microwave and Optical Transmission, John Wiley, New York Additional up-to-date reading information will be provided at the beginning of the lecture.
Type and form of assessment	Not applicable
Grading of the assessment	Not applicable
Further information	Not applicable

Unit description

Unit description 2 of Module 11 Alternative 1 **Project in Engineering of Optical Systems**

Name of the unit	Project in Engineering of Optical Systems
Code	
Corresponding module	Engineering of Optical Systems
Lecturer	Zimmer
Contents of the unit	Project in Engineering of Optical Systems
Teaching methods	Project
Contact hours per week	1
Total workload of the unit (h)	105
Total time of contact hours (h)	15
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	The self-study and contact hours (see above/below) includes the practical training.
Total time of self-study (h)	90
Language of the unit	English
Recommended reading	Worksheets
Type and form of assessment	See module description
Grading of the assessment	Graded
Further information	Not applicable

Module description

Module description of Module 11 Alternative 2 **Engineering of Microwave Systems**

Study programme	Information Technology
Module title	Engineering of Microwave Systems
Module number	11
Module code	
Units	Lectures in Engineering of Microwave Systems Engineering of Microwave Systems Project
Level	Advanced level course
Applicability of the module to other study programmes	
Duration of the module	1 semester
Status of the module	Elective module
Recommended semester during the study programme	3
Credit points (Cp) of the module	5
Prerequisites for module participation	None
Recommended contents of previous modules	Module 10
Prerequisites for module examination	None
Module examination	Written documentation of project result and presentation (15-20 minutes), English
Intended learning outcomes /acquired competences of the module	Students gain knowledge of different system architectures in the field of microwave. They understand the design process and the requirements of the selected system architectures and are qualified to do independent work in electromagnetic field theory in the domain of microwaves.
Contents of the module	Lectures in Engineering of Microwave Systems Engineering of Microwave Systems Project
Teaching methods of the module	Lectures and Project
Total workload	150 h
Language of the module	English
Frequency of the module	Annually
Module coordination	Zimmer
Further information	Not applicable

Unit description

Unit description 1 of Module 11 Alternative 2 **Lectures in Engineering of Microwave Systems**

Name of the unit	Lectures in Engineering of Microwave Systems
Code	
Corresponding module	Engineering of Microwave Systems
Lecturer	Zimmer
Contents of the unit	System architecture of different microwave systems e.g. Wireless LANs, microwave sensors; component requirements to design and build the physical layers
Teaching methods	Lecture
Contact hours per week	2
Total workload of the unit (h)	45
Total time of contact hours (h)	30
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	0
Total time of self-study (h)	15
Language of the unit	English
Recommended reading	D. M. Dobkin, RF-Engineering for wireless Networks, Elsevier Olver, A. D.: Microwave and Optical Transmission, John Wiley, New York Additional up-to-date reading information will be provided at the beginning of the lecture.
Type and form of assessment	Not applicable
Grading of the assessment	Not applicable
Further information	Not applicable

Unit description

Unit description 2 of Module 11 Alternative 2 **Project in Engineering of Microwave Systems**

Name of the unit	Project in Engineering of Microwave Systems
Code	
Corresponding module	Engineering of Microwave Systems
Lecturer	Zimmer
Contents of the unit	Project in Engineering of Microwave Systems
Teaching methods	Project
Contact hours per week	1
Total workload of the unit (h)	105
Total time of contact hours (h)	15
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	The self-study and contact hours (see above/below) includes the practical training.
Total time of self-study (h)	90
Language of the unit	English
Recommended reading	Worksheets
Type and form of assessment	See module description
Grading of the assessment	Graded
Further information	Not applicable

Module description

Module description of Module 11 Alternative 3 Optional technical subject **Digital Control System Design**

Study programme	Information Technology
Module title	Digital Control System Design
Module number	11
Module code	
Units	Lectures in Digital Control System Design Laboratory in Digital Control System Design
Level	Advanced level course
Applicability of the module to other study programmes	
Duration of the module	1 semester
Status of the module	Elective module
Recommended semester during the study programme	3
Credit points (Cp) of the module	5
Prerequisites for module participation	None
Recommended contents of previous modules	Module 16.2
Prerequisites for module examination	Written laboratory work documentation, English
Module examination	Written examination, 90 minutes, English
Intended learning outcomes /acquired competences of the module	On successful completion of the subject the students will be able to design digital control systems using digital controllers with individually designed control algorithms. The students will be able to choose the correct algorithm and suite it to a given engineering project.
Contents of the module	Lectures in Digital Control System Design Laboratory in Digital Control System Design
Teaching methods of the module	Lectures and Laboratory
Total workload	150 h
Language of the module	English
Frequency of the module	Annually
Module coordination	Kühn
Further information	Not applicable

Unit description

Unit description 1 of Module 11 Alternative 3 **Lectures in Digital Control System Design**

Name of the unit	Lectures in Digital Control System Design
Code	
Corresponding module	Digital Control System Design
Lecturer	Kühn
Contents of the unit	Structure of closed loop sampled data systems, representation in the time-domain and in the z-domain, block diagram analysis of closed loop sampled data systems, sample spectra and aliasing, hold circuits as low pass filters, digital control system analysis and design using transform techniques and direct design, digital control system analysis and design using state space techniques
Teaching methods	Lecture
Contact hours per week	2
Total workload of the unit (h)	60
Total time of contact hours (h)	30
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	0
Total time of self-study (h)	30
Language of the unit	English
Recommended reading	Worksheets
Type and form of assessment	See module description
Grading of the assessment	Graded
Further information	Not applicable

Unit description

Unit description 2 of Module 11 Alternative 3 **Laboratory in Digital Control System Design**

Name of the unit	Laboratory in Digital Control System Design
Code	
Corresponding module	Digital Control System Design
Lecturer	Kühn
Contents of the unit	Laboratory experiments: implementation of control algorithms and performance study
Teaching methods	Laboratory
Contact hours per week	1
Total workload of the unit (h)	90
Total time of contact hours (h)	15
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	0
Total time of self-study (h)	75
Language of the unit	English
Recommended reading	Worksheets
Type and form of assessment	See module description
Grading of the assessment	Passed/failed
Further information	For the laboratory a timely registration is needed, details are announced on the information board of the laboratory.

Module description

Module description of Module 12 **Image Processing and Identification of Dynamic Systems**

Study programme	Information Technology
Module title	Image Processing and Identification of Dynamic Systems
Module number	12
Module code	
Units	Lectures and Exercises in Image Processing Lectures and Exercises in Identification of Dynamic Systems
Level	Advanced level course
Applicability of the module to other study programmes	
Duration of the module	1 semester
Status of the module	Compulsory module
Recommended semester during the study programme	2
Credit points (Cp) of the module	5
Prerequisites for module participation	None
Recommended contents of previous modules	None
Prerequisites for module examination	None
Module examination	Written examination, 90 minutes, English
Intended learning outcomes /acquired competences of the module	On successful completion of the subject image processing the student will have a thorough knowledge in image processing. He/she will be able to plan and operate image processing and real world conditions. On successful completion of the unit identification of dynamic systems the student has got an inside view of system identification and classification methods. He/she will be able to use basic methods of signal and process modelling to detect faults, failures and malfunctions. He will be able to work with fault diagnosis systems using a basic knowledge of classification methods.
Contents of the module	Lectures combined with Exercises in Image Processing Lectures combined with Exercises in Identification of Dynamic Systems
Teaching methods of the module	Lecture
Total workload (in the case of bachelor or master thesis, description of the workload is needed for the colloquium)	150 h
Language of the module	English
Frequency of the module	Annually
Module coordination	Jungke

Further information	Not applicable

Unit description

Unit description 1 of Module 12 **Lectures combined with exercises in Image Processing**

Name of the unit	Lectures combined with exercises in Image Processing
Code	Unit 1 of Module 12
Corresponding module	Image Processing and Identification of Dynamic Systems
Lecturer	Goerick
Contents of the unit	Modelling illumination and imaging, image transfer function, spatial resolution, contrast enhancement through illumination, optics, camera technology, image acquisition, image memory, image processing hardware, pattern recognition algorithms for image processing
Teaching methods	Lectures combined with exercises
Contact hours per week	3
Total workload of the unit (h)	90
Total time of contact hours (h)	45, thereof exercises 15h
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	0
Total time of self-study (h)	45
Language of the unit	English
Recommended reading	Jähne, B: Digital Image Processing, Springer Bovik, A: Handbook of Imaging and Video Processing, Academic Press Gonzalez, R; Woods, R: Digital Image Processing, Prentice Hall Additional up-to-date reading information will be provided at the beginning of the lecture.
Type and form of assessment	See module description
Grading of the assessment	Graded
Further information	Not applicable

Unit description

Unit description 2 of Module 12 **Lectures combined with exercises in Identification of Dynamic Systems**

Name of the unit	Lectures combined with exercises in Identification of Dynamic Systems
Code	Unit 2 of Module 12
Corresponding module	Image Processing and Identification of Dynamic Systems
Lecturer	Jungke
Contents of the unit	Theoretical and experimental modelling of dynamic systems, system identification using discrete deterministic and discrete stochastic signals, least-squares estimation, tasks and terminology of supervision and fault management of processes, fault models, discrete time dynamic process models, signal models, fault detection with signal models, fault detection with process identification models, fault diagnosis with classification methods
Teaching methods	Lectures combined with exercises
Contact hours per week	2
Total workload of the unit (h)	60
Total time of contact hours (h)	30, thereof exercises: 10
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	0
Total time of self-study (h)	30
Language of the unit	English
Recommended reading	Isermann, Rolf: Identifikation dynamischer Systeme, Springer Verlag Vachtsevanos, George et al.: Intelligent Fault Diagnosis and Prognosis for Engineering Systems, Wiley – VCH Verlag Isermann, Rolf: Fault-Diagnosis Systems, Springer Verlag Additional up-to-date reading information will be provided at the beginning of the lecture.
Type and form of assessment	See module description
Grading of the assessment	Graded
Further information	None

Module description

Module description of Module 13 **Automation Laboratory**

Study programme	Information Technology
Module title	Automation Laboratory
Module number	13
Module code	
Units	Project Automation Laboratory
Level	Advanced level course
Applicability of the module to other study programmes	
Duration of the module	1 semester
Status of the module	Compulsory module
Recommended semester during the study programme	3
Credit points (Cp) of the module	5
Prerequisites for module participation	None
Recommended contents of previous modules	Module 1 to 7, 9, and 12
Prerequisites for module examination	None
Module examination	Project, processing time 1 semester
Intended learning outcomes /acquired competences of the module	Qualification to do independent practical work on intelligent systems in automation. The student will be able to analyse, to specify and to develop intelligent systems for automation tasks.
Contents of the module	Project Automation Laboratory
Teaching methods of the module	Project
Total workload	150 h
Language of the module	English
Frequency of the module	Annually
Module coordination	Pech
Further information	Not applicable

Unit description

Unit description 1 of Module 13 **Project Automation Laboratory**

Name of the unit	Project Automation Laboratory
Code	
Corresponding module	Automation Laboratory
Lecturer	Pech, Nauth
Contents of the unit	Laboratory project on intelligent systems in automation
Teaching methods	Project
Contact hours per week	1
Total workload of the unit (h)	150
Total time of contact hours (h)	15
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	The self-study and contact hours (see below/above) includes the practical training.
Total time of self-study (h)	135
Language of the unit	English
Recommended reading	Up-to-date reading information will be provided at the beginning of the project
Type and form of assessment	See module description
Grading of the assessment	Graded
Further information	For the laboratory a timely registration is needed, details are announced on the information board of the laboratory.

Module description

Module description of Module 14 **Computational Intelligence**

Study programme	Information Technology
Module title	Computational Intelligence
Module number	14
Module code	
Units	Seminar in Computational Intelligence
Level	Advanced level course
Applicability of the module to other study programmes	
Duration of the module	1 semester
Status of the module	Compulsory module
Recommended semester during the study programme	3
Credit points (Cp) of the module	5
Prerequisites for module participation	None
Recommended contents of previous modules	Module 1, 2, 7, and 12
Prerequisites for module examination	None
Module examination	Written seminar assignment (processing duration 6 weeks) and oral presentation (min. 45, max. 60 minutes)
Intended learning outcomes /acquired competences of the module	On successful completion of the subject the students will have a thorough understanding in the theory of computational intelligence. They will be able to analyse computation problems, to develop strategies and algorithms for a problem solution and to specify the respective hardware and software structure.
Contents of the module	Seminar in Computational Intelligence
Teaching methods of the module	Seminar
Total workload	150 h
Language of the module	English
Frequency of the module	Annually
Module coordination	Pech
Further information	Not applicable

Unit description

Unit description 1 of Module 14 **Seminar in Computational Intelligence**

Name of the unit	Seminar in Computational Intelligence
Code	
Corresponding module	Computational Intelligence
Lecturer	Pech, Nauth
Contents of the unit	Computational intelligence and knowledge, representation and reasoning systems, knowledge engineering, uncertain knowledge, learning; situated robots, agent models; approaches and structures of artificial neural networks and fuzzy systems, additional topics like quantum computing, swarm intelligence, human-centric systems or granular systems, pattern recognition systems, learning strategies and algorithms, applications
Teaching methods	Seminar
Contact hours per week	4
Total workload of the unit (h)	150
Total time of contact hours (h)	60
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	0
Total time of self-study (h)	90
Language of the unit	English
Recommended reading	Up-to-date reading information will be provided at the beginning of the seminar
Type and form of assessment	See module description
Grading of the assessment	Graded
Further information	Not applicable

Module description

Module description of Module 15 **Autonomous Intelligent Systems**

Study programme	Information Technology
Module title	Autonomous Intelligent Systems
Module number	15
Module code	
Units	Lectures in Autonomous Intelligent Systems
Level	Advanced level course
Applicability of the module to other study programmes	
Duration of the module	1 semester
Status of the module	Compulsory module
Recommended semester during the study programme	3
Credit points (Cp) of the module	5
Prerequisites for module participation	None
Recommended contents of previous modules	None
Prerequisites for module examination	None
Module examination	Project, processing time 1 semester
Intended learning outcomes /acquired competences of the module	The students will have a thorough knowledge regarding the architecture, hardware and software of autonomous systems. They are familiar with intelligent algorithms and their application in intelligent sensors, action planning and decision making.
Contents of the module	Lectures in Autonomous Intelligent Systems Project in Autonomous Intelligent Systems
Teaching methods of the module	Lectures and project
Total workload	150 h
Language of the module	English
Frequency of the module	Annually
Module coordination	Nauth
Further information	Not applicable

Unit description

Unit description 1 of Module 15 **Lectures in Autonomous Intelligent Systems**

Name of the unit	Lectures in Autonomous Intelligent Systems
Code	
Corresponding module	Autonomous Intelligent Systems
Lecturer	Nauth
Contents of the unit	Autonomous Systems: Architecture, hardware, environmental sensing, sensor fusion, autonomous decision making, planning, plan execution, human machine interaction, programming of autonomous systems Intelligent Sensors for Autonomous Systems: Technology and characteristics of microcontroller for intelligent sensors, design of intelligent sensors, programming of algorithms for signal processing and pattern recognition, examples of intelligent sensors for applications in autonomous systems Actors: Types of actors, actor control
Teaching methods	Lecture
Contact hours per week	2
Total workload of the unit (h)	45
Total time of contact hours (h)	30
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	0
Total time of self-study (h)	15
Language of the unit	English
Recommended reading	H.-N.Teodorescu, D.Mlynek, A.Kandel, H.-J.Zimmermann: Intelligent Systems and Interfaces, Springer Verlag, 2000 P. Nauth: Embedded Intelligent Systems, Oldenbourg Verlag, 2005 Additional up-to-date reading information will be provided at the beginning of the lecture.
Type and form of assessment	Not applicable
Grading of the assessment	Not applicable
Further information	Not applicable

Unit description

Unit description 2 of Module 15 **Project in Autonomous Intelligent Systems**

Name of the unit	Project in Autonomous Intelligent Systems
Code	
Corresponding module	Autonomous Intelligent Systems
Lecturer	Nauth, Pech, Grote, Michalik
Contents of the unit	Projects regarding design, programming and application of autonomous systems
Teaching methods	Project
Contact hours per week	1
Total workload of the unit (h)	105
Total time of contact hours (h)	15
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	The self-study and contact time (see below/above) includes the practical training.
Total time of self-study (h)	90
Language of the unit	English
Recommended reading	Worksheets
Type and form of assessment	See module description
Grading of the assessment	Graded
Further information	Not applicable

Module description

Module description of Module 16 Alternative 1 Optional technical subject **Numerical Field Theory with C++**

Study programme	Information Technology
Module title	Numerical Field Theory with C++
Module number	16
Module code	
Units	Seminar in Numerical Field Theory with C++
Level	Advanced level course
Applicability of the module to other study programmes	
Duration of the module	1 semester
Status of the module	Elective module
Recommended semester during the study programme	2
Credit points (Cp) of the module	5
Prerequisites for module participation	None
Recommended contents of previous modules	Module 10, 11
Prerequisites for module examination	None
Module examination	Colloquium with presentation
Intended learning outcomes /acquired competences of the module	Students will qualify to do independent work in electromagnetic field theory in the domain of optics and microwaves. They will extend their knowledge of different numerical techniques e.g. “Moment Method” to solve electromagnetic boundary problems.
Contents of the module	Seminar in Numerical Field Theory with C++
Teaching methods of the module	Seminar
Total workload	150 h
Language of the module	English
Frequency of the module	Annually
Module coordination	Zimmer
Further information	Not applicable

Unit description

Unit description 1 of Module 16 Alternative 1 **Seminar in Numerical Field Theory with C++**

Name of the unit	Seminar in Numerical Field Theory with C++
Code	
Corresponding module	Numerical Field Theory with C++
Lecturer	Zimmer
Contents of the unit	Method of Moments, point matching, sub sectional bases, approximate operators, operator formulation of electrostatic field problems, implementation aspects in C++, formulation of the problem of wire antennas and scatterers, matrix solution, implementation possibilities with C++
Teaching methods	Seminar
Contact hours per week	2
Total workload of the unit (h)	150
Total time of contact hours (h)	30
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	0
Total time of self-study (h)	120
Language of the unit	English
Recommended reading	Harrington, R., F.: Field Computation by Moment Methods, IEEE Press, New York Additional up-to-date reading information will be provided at the beginning of the lecture.
Type and form of assessment	See module description
Grading of the assessment	Graded
Further information	Not applicable

Module description

Module description of Module 16 Alternative 2 Optional technical subject **Modern Control Theory**

Study programme	Information Technology
Module title	Modern Control Theory
Module number	16
Module code	
Units	Lectures in Modern Control Theory
Level	Advanced level course
Applicability of the module to other study programmes	
Duration of the module	1 semester
Status of the module	Elective module
Recommended semester during the study programme	2
Credit points (Cp) of the module	5
Prerequisites for module participation	None
Recommended contents of previous modules	None
Prerequisites for module examination	None
Module examination	Written examination, 90 minutes, English
Intended learning outcomes /acquired competences of the module	On successful completion of the subject the students will understand state space methods, be able to compare them with classical methods and apply them in control system analysis and design
Contents of the module	Lectures in Modern Control Theory
Teaching methods of the module	Lecture
Total workload	150 h
Language of the module	English
Frequency of the module	Annually
Module coordination	Kühn
Further information	Not applicable

Unit description

Unit description 1 of Module 16 Alternative 2 **Lectures in Modern Control Theory**

Name of the unit	Lectures in Modern Control Theory
Code	
Corresponding module	Modern Control Theory
Lecturer	Kühn
Contents of the unit	State space representation of linear dynamic systems (continuous time and discrete time), solution of the state equation, transition matrix, stability, controllability, observability, canonical forms, state variable feedback regulator design, pole placement, optimum control, observer design
Teaching methods	Lecture
Contact hours per week	3
Total workload of the unit (h)	150
Total time of contact hours (h)	45
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	0
Total time of self-study (h)	105
Language of the unit	English
Recommended reading	Worksheets
Type and form of assessment	Not applicable
Grading of the assessment	Not applicable
Further information	Not applicable

Module description

Module description of Module 16 Alternative 3 Optional technical subject **Wireless System Design**

Study programme	Information Technology
Module title	Wireless System Design
Module number	16
Module code	
Units	Lectures with integrated exercises in Wireless System Design Laboratory in Wireless System Design
Level	Advanced level course
Applicability of the module to other study programmes	
Duration of the module	1 semester
Status of the module	Elective module
Recommended semester during the study programme	2
Credit points (Cp) of the module	5
Prerequisites for module participation	None
Recommended contents of previous modules	Module 3, 4, 6, 10
Prerequisites for module examination	Written laboratory work documentation, English
Module examination	Written examination, 90 minutes, English and laboratory work documentation
Intended learning outcomes /acquired competences of the module	On successful completion of the subject the student will be able to design digital control systems using digital controllers with individually designed control algorithms.
Contents of the module	Lectures in Digital Control System Design Laboratory in Digital Control System Design
Teaching methods of the module	Lecture and Laboratory
Total workload	150 h
Language of the module	English
Frequency of the module	Annually
Module coordination	Kastell
Further information	Not applicable

Unit description

Unit description 1 of Module 16 Alternative 3 **Lectures with integrated exercises in Wireless System Design**

Name of the unit	Lectures with integrated exercises in Wireless System Design
Code	
Corresponding module	Wireless System Design
Lecturer	Kastell
Contents of the unit	Differences between wireless systems: mobility, access scheme, network components Basics of propagation over the air interface and propagation models Network protocols and network security
Teaching methods	Lecture with integrated exercises
Contact hours per week	2
Total workload of the unit (h)	60
Total time of contact hours (h)	30
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	0
Total time of self-study (h)	30
Language of the unit	English
Recommended reading	Lecture notes Additional up-to-date reading information will be provided at the beginning of the lecture.
Type and form of assessment	See module description
Grading of the assessment	Graded
Further information	Not applicable

Unit description

Unit description 2 of Module 16 Alternative 3 **Laboratory in Wireless System Design**

Name of the unit	Laboratory in Wireless System Design
Code	
Corresponding module	Wireless System Design
Lecturer	Kastell
Contents of the unit	Laboratory experiments: the mobile channel (stochastic channel models), network planning tools, conceptual network design
Teaching methods	Laboratory
Contact hours per week	1
Total workload of the unit (h)	90
Total time of contact hours (h)	15
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	0
Total time of self-study (h)	75
Language of the unit	English
Recommended reading	Worksheets Additional up-to-date reading information will be provided at the beginning of the lecture.
Type and form of assessment	See module description
Grading of the assessment	Passed/failed
Further information	For the laboratory a timely registration is needed, details are announced on the information board of the laboratory.

Module description

Module description of Module 17 **International Project Management and Business Administration**

Study programme	Information Technology
Module title	International Project Management and Business Administration
Module number	17
Module code	
Units	Lectures in International Project Management Lectures in Business Administration
Level	Advanced level course
Applicability of the module to other study programmes	
Duration of the module	1 semester
Status of the module	Compulsory module
Recommended semester during the study programme	1
Credit points (Cp) of the module	5
Prerequisites for module participation	None
Recommended contents of previous modules	None
Prerequisites for module examination	None
Module examination	Written examination, 90 minutes, English
Intended learning outcomes /acquired competences of the module	On successful completion of the subject the student will have the ability to plan, organize and execute complex international technical projects and will be familiarized with the structure and essential functions of operations.
Contents of the module	Lectures in International Project Management Lectures in Business Administration
Teaching methods of the module	Lectures
Total workload	150 h
Language of the module	English
Frequency of the module	Annually
Module coordination	Nosko
Further information	Not applicable

Unit description

Unit description 1 of Module 17 **Lectures in International Project Management**

Name of the unit	Lectures in International Project Management
Code	
Corresponding module	International Project Management and Business Administration
Lecturer	Kühn
Contents of the unit	The nature of international business, specifics of international projects, activities until contract award, post award contract administration: project organization, project control, quality control, documentation, reports; technical project management from design to commercial operation
Teaching methods	Lecture and accompanying project
Contact hours per week	2
Total workload of the unit (h)	75
Total time of contact hours (h)	30
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	0
Total time of self-study (h)	45
Language of the unit	English
Recommended reading	Murch, R.: International Project Management Litke, H.-D.: Internationales Projektmanagement Additional up-to-date reading information will be provided at the beginning of the lecture.
Type and form of assessment	See module description
Grading of the assessment	Graded
Further information	Not applicable

Unit description

Unit description 2 of Module 17 **Lectures in Business Administration**

Name of the unit	Lectures in Business Administration
Code	
Corresponding module	International Project Management and Business Administration
Lecturer	Nosko
Contents of the unit	Operations structure and functions, legal and regulatory environment, business planning, financing, cost accounting, industrial marketing, human resource management, ethics in business
Teaching methods	Lecture
Contact hours per week	2
Total workload of the unit (h)	75
Total time of contact hours (h)	30
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	0
Total time of self-study (h)	45
Language of the unit	English
Recommended reading	Wheelen, T./ Hunger, D.: Strategic Management, Addison Wesley Deresky, H.: International Management, Prentice Hall Porter, M.: Competition in Global Industries, Harvard Business School Press Additional up-to-date reading information will be provided at the beginning of the lecture.
Type and form of assessment	See module description
Grading of the assessment	Graded
Further information	Not applicable

Module description

Module description of Module 18 **Project**

Study programme	Information Technology
Module title	Project
Module number	18
Module code	
Units	Project
Level	Advanced level course
Applicability of the module to other study programmes	
Duration of the module	1 semester
Status of the module	Compulsory module
Recommended semester during the study programme	3
Credit points (Cp) of the module	5
Prerequisites for module participation	None
Recommended contents of previous modules	None
Prerequisites for module examination	None
Module examination	Project, processing time 1 semester
Intended learning outcomes /acquired competences of the module	On successful completion of the subject the student will be able to do requirements engineering and to evolve problem solution strategies. He/she will be able to present technical projects.
Contents of the module	Project
Teaching methods of the module	Project
Total workload	150 h
Language of the module	English
Frequency of the module	Every semester
Module coordination	Pech
Further information	Not applicable

Unit description

Unit description 1 of Module 18 **Project**

Name of the unit	Project
Code	
Corresponding module	Project
Lecturer	All Professors contributing to this Master Program
Contents of the unit	Depending on the projects subject
Teaching methods	Project
Contact hours per week	2
Total workload of the unit (h)	150
Total time of contact hours (h)	30
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	The self-study and the contact hours (see below/above) includes the practical training.
Total time of self-study (h)	120
Language of the unit	English
Recommended reading	Depending on the projects subject
Type and form of assessment	See module description
Grading of the assessment	Graded
Further information	Not applicable

Module description

Module description of Module 19 **Master Thesis with Colloquium**

Study programme	Information Technology
Module title	Project
Module number	19
Module code	
Units	Master Thesis with Colloquium
Level	Advanced level course
Applicability of the module to other study programmes	
Duration of the module	1 semester
Status of the module	Compulsory module
Recommended semester during the study programme	4
Credit points (Cp) of the module	30
Prerequisites for module participation	Successful completion of Modules 1 to 18
Recommended contents of previous modules	Depending on the chosen topic
Prerequisites for module examination	None
Module examination	Documentation and colloquium, 30 – 45 minutes, English
Intended learning outcomes /acquired competences of the module	On successful completion of the master thesis the student acquires the ability to plan, organize, develop, operate and present all kinds of information technology systems due to real world requirements.
Contents of the module	Master Thesis
Teaching methods of the module	Project
Total workload (in the case of bachelor or master thesis, description of the workload is needed for the colloquium)	900 h
Language of the module	English
Frequency of the module	Every semester
Module coordination	Pech
Further information	Not applicable

Unit description

Unit description 1 of Module 19 **Master thesis with Colloquium**

Name of the unit	Master thesis with colloquium
Code	
Corresponding module	Master thesis
Lecturer	All Professors contributing to this Master Program
Contents of the unit	Depending on the Master thesis subject
Teaching methods	Project
Contact hours per week	6
Total workload of the unit (h)	900
Total time of contact hours (h)	90
Total time of examination incl. preparation (h)	The self-study (see below) includes the preparation for the module examination.
Total time of practical training (h)	The self-study and the contact hours (see below/above) includes the practical training.
Total time of self-study (h)	810
Language of the unit	English
Recommended reading	Depending on the Master thesis subject
Type and form of assessment	See module description
Grading of the assessment	Graded
Further information	Not applicable