Hochschule Nordhausen

Fachbereich Ingenieurwissenschaften

Modulhandbuch für den Studiengang

Computer Engineering for IoT Systems

Erstellungsdatum: 10.11.2024

Modulübersicht für den Studiengang Computer Engineering for IoT Systems

0. Fachsemester				
ID	**Modulname**	**Version**	**ECTS**	**Verwendbarkeit**
255	Verteilte Systeme / Distributed Systems	1	5.0	PFLICHT
716	Informatics and Communication Technology	1	5.0	PFLICHT
870	Basics in Electrical Engineering	2	5.0	PFLICHT
873	Scientific Practice and Writing	1	5.0	PFLICHT
908	German as a Foreign Language I	2	5.0	PROFIL
912	Technical English I	1	5.0	PROFIL
1024	IT-Service Management	1	5.0	PFLICHT
1. Fachsemester				
ID	**Modulname**	**Version**	**ECTS**	**Verwendbarkeit**
568	Project Management	1	5.0	WAHLPFLICHT
755	Industry 4.0	1	5.0	WAHLPFLICHT
761	Bussystems in Energy and Sensor Networks	1	5.0	WAHLPFLICHT
781	Dependable System Design	1	5.0	PFLICHT
783	Signals and Control	1	5.0	PFLICHT
784	Seminar on topics in computer engineering	1	5.0	PFLICHT
787	Embedded Smart Systems	1	5.0	PFLICHT
910	German as a Foreign Language II	2	5.0	PROFIL
914	Technical English II	1	5.0	PROFIL
1013	Mechatronic Systems	1	5.0	WAHLPFLICHT
2. Fachsemester				
ID	**Modulname**	**Version**	**ECTS**	**Verwendbarkeit**
732	Lifecycle Assessment	1	5.0	WAHLPFLICHT
762	Data Science in Python	2	5.0	WAHLPFLICHT
780	Wireless Sensor Networks	1	5.0	PFLICHT
782	Embedded Software Design and Programming	1	5.0	PFLICHT
786	Cloud Computing and Big Data	1	5.0	PFLICHT
788	IT-System Performance Analysis	1	5.0	PFLICHT
789	Scientific Seminar	1	5.0	PFLICHT
791	Digital Transformation (ICM 15/16)	1	7.0	WAHLPFLICHT
8000	Study success and career progression	1	5.0	WAHLPFLICHT
3. Fachsemester				
ID	**Modulname**	**Version**	**ECTS**	**Verwendbarkeit**
940	Master Thesis CES	1	30.0	PFLICHT

Modul-No.	255	MA	
Modul name	**Verteilte Systeme / Distributed Systems**		
Modul coordinator	Schölzel, Mario		
Title	Verteilte Systeme / Distributed Systems		
Title of examination	Verteilte Systeme / Distributed Systems		
Course Type / SWS	4 SWS Lecture/Exercise		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives

Content:
Types and Basics of Distributed Systems, architecture models and examples of distributed systems, processes and threads and their application in concurrent distributed systems, communication oriented middleware (Messages, MPI), RPC/RMI, inter-process communication and –coordination in distributed systems (time synchronization, choice algorithms, mutual exclusion and synchronization), application oriented middleware (Java EE), organization of persistance, organisation of transactions.

Objectives:
After successful completion of the course the students:

- understand fundamental problems in distributed systems
- know techniques to overcome these problems
- recognize advantages and disadvantages of various solutions
- are able to develop and implement simple communication-oriented distribute applications using basic operating systems primitives as well as middleware mechanisms.
- understand the basic concepts of application oriented middleware platforms
- Bachelor students can apply their English language skills

Recommended Literature

- M. van Steen and A.S. Tanenbaum, Distributed Systems, 3rd ed., 2017.
- Coulouris, Dollimore & Kindberg: Distributed Systems – Concepts and Design. 4. Auflage, Addison Wesley
- C. Baun, M. Kunze, J. Nimis, S. Tai: Cloud Computing: Web-basierte dynamische IT-Services Springer-Verlag, 2011
- K. Hwang, J. Dongarra, G. Fox: Distributed and Cloud Computing Morgan Kaufmann, 2011
- William Gropp, Ewing Lusk, Anthony Skjellum: Using MPI, Portable Parallel Programming with the Message-Passing Interface, Third Edition, Scientific and Engineering Computation, 2014.
- Simon Hoffmann, Rainer Lienhart, OpenMP - Eine Einführung in die parallele Programmierung mit C/C++. Berlin: Spring, 2008. ISBN 978-3-540-73123-8
- Alexander Salvanos: Professionell entwickeln mit Java EE 8, Rheinwerk Verlag Bonn, 2. Auflage, 2018.

Forms of teaching / Prerequisites for participation

This course is taught as lecture with integrated exercises. Students have to prepare programming exercises for the various topics of the lecture at home.

Usability of module

This module is mandatory for: Computer Engineering for IoT Systems

Requirements for receiving ECTS credit points

Assessment is performed either as written examination (90 minutes) for Master students or as 30 minutes oral examination for Bachelor students. Students need to pass the module examination, which encompasses all contents of the lecture.
Examination in the Bachelor course is offered in German Language.

ECTS credit points and grading

Upon passing the examination, the student receives 5 ECTS. Master students have to solve more complex exercises and examination tasks.

Frequency of offer / Duration of module	
WINTER	1 semester
Work load	
150 h of total work load, from: 45 h of presence at lectures/exercises 55 h of self-study 50 h of preparation for examination	

Modul-No.	568	MA	
Modul name	**Project Management**		
Modul coordinator	Rutz, Michael		
Title	Project Management		
Title of examination	Project Management		
Course Type / SWS	3 SWS Lecture / 1 SWS Exercise		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives

Content:
1 Basics
• definition and characteristics of projects • short history of Project Management • Project Life Cycle
2 Initialisation
• project goals • Stakeholder Analysis • rough planning • Project Organisation
3 Planning
• Project Structuring • Time Management • Resource Planning
4 Execution
• role of Project Manager and Project Team • Team Development • Project Management • Communication • Risk Management • Quality Management
5 Project Closing
6 Agile Project Management
• advantages of agile methods • Scrum

Learning objectives: Students are able to plan projects and organise their implementation. They have learned the basics of project management for industrial applications. They have an overview of selected methods, tools (software) and information systems for planning and controlling industrial projects. The students are able to plan, organise and document a project with the help of a project example. They are able to present the project idea, the progress and the results.

Recommended Literature

Dionisio, Cynthia Snyder (2018): A project manager´s book of tools and techniques. a companion to the PMBOK Gui-de. Hoboken, New Jersey: Wiley.
Lester, Albert (2014): Project Management, planning and control. Managing Engineering, Construction and Manufac-turing Projects to PMI, APM and BSI Standards. 6. Aufl. Oxford: Butterworth-Heinemann.
Project Management Institute, Inc. (2021): A Guide to the Project Management Body of Knowledge (PMBOK Guide) and The Standard for Project Management. 7. Aufl.

Forms of teaching / Prerequisites for participation

This module is a classical lecture combined with exercises. There are no formal requirements for participation.

Usability of module

This module is elective for: Computer Engineering for IoT Systems

Requirements for receiving ECTS credit points

no formal requirements

ECTS credit points and grading

Students need to pass the module examination, which encompasses all contents of the lecture. Type of examination: written examination with a duration of 120 min. Alternative types of examination are possible The grade corresponds to the grading of the written examination or the submitted project documentation. When com-pleting the unit successfully, students are granted 5 credit points (ECTS).

Frequency of offer / Duration of module

SOMMER	The module is lectured in one semester.

Work load

The total workload for this module is 150 hours; this corresponds to 5 ECTS credits. This workload results from the presence at the lectures with with integrated exercises (about 45 hours). As part of the self-study, the lecture material should be reworked (about 55 hours). The preparation and execution of the examination is about 50 hours.

Modul-No.	716	MA	
Modul name	**Informatics and Communication Technology**		
Modul coordinator	Hühn, Thomas		
Title	Informatics and Communication Technology		
Title of examination	Informatics and Communication Technology		
Course Type / SWS	2 SWS Lecture / 2 SWS Exercise		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives

Content:

a) Informatics

- Introduction: Information processing in technological systems, information processing systems, IPO-mode
- Basics of coding
- IP-Systems without memory circuits: Normal Form theorem
- IP-Systems with memory circuits and automata
- Flip-Flops, creation of a memory through feedback, basics of automation theory
- Computers as programmable systems with memory, Von-Neumann Architecture
- Solvability of problems: Computability of problems, Turing machine, complexity

b) Communication Technology

- Introduction into information theory
- Signals in time and frequency domain
- Analog-Digital-Conversion
- Baseband transmission and line coding
- Digital modulation and demodulation
- dB-calculation

Objectives:

The lecture submits basics knowledge about computers which enable engineers and computer scientist to en-hance their usage, developing and programming of computers. The students are able to understand the relation between bits in a computer and bits as information (quantity of information) and they will be aware that the in-terpretation (decoding) of bits is always context-sensitive. On completion, they are able to work and calculate with binary numbers (unsigned, complement of two, floating-point number). The attendants will master the de-scription of information through bits, octal numbers and hexadecimal. Furthermore, the students will be able to describe simple sequential information-processing problems as automata.

The students can display and explain communication relations as source-sink relation and apply the model of digital transmission on any communication scenario. They are familiar with the substance of information and the correlation of Information – Message (Data). The students know the basic terms of the information theory. They can classify continues and discrete information sources and know the meaning of important categories such as entropy (in information theory), redundance, redundancy reduction (entropy encoding) and can calcu-late the redundance and entropy for simple and discrete sources. They know about the relation of redundance and error correction. They can estimate the ability of code for error correction on basis of the Hamming distance.

The students know the analog-digital-conversion as source encoding of continuous sources. They master the sampling-theorem and the description of quantization errors with the help of the quantization noise.

The students can recognize the source coding/decoding as interface between information source or sink and digital channel, in the model of the digital transmission. They will be able to determine transfer functions through measurements. They know and master the essential digital modulation schemes and line coding schemes and can distinguish between bitrate, bandwidth and symbol rate (signal alternation speed). The acquisition of appli-cation-oriented knowledge is maintained especially through the conduction of laboratory experiments.

Recommended Literature

- Proakis, John u.a.: Grundlagen der Kommunikationstechnik. Pearson Studium 2004
- Widenfeller, Hermann: Grundlagen der Kommunikationstechnik. Teubner Stuttgart 2002.
- Mildenberger, O.: Informationstechnik kompakt; Theoretische Grundlagen. Viehweg Braunschweig 1999.

- Kreß, Dieter; Kaufhold, Benno: Signale und Systeme verstehen und vertiefen. Vieweg und Teubner Verlag Wiesbaden, 2010.

Forms of teaching / Prerequisites for participation

Lecture with integrated exercises
The students receive next to the lecture script a summary of exercises and instruction for the conduction of ex-periments in the laboratory. Those manuals contain a theory part that deepen the required knowledge for con-ducting the experiments. The following literature is recommended for the preparation or postprocessing of the course:

- Proakis, John u.a.: Grundlagen der Kommunikationstechnik. Pearson Studium 2004
- Widenfeller, Hermann: Grundlagen der Kommunikationstechnik. Teubner Stuttgart 2002.
- Mildenberger, O.: Informationstechnik kompakt; Theoretische Grundlagen. Viehweg Braunschweig 1999.
- Kreß, Dieter; Kaufhold, Benno: Signale und Systeme verstehen und vertiefen. Vieweg und Teubner Verlag Wiesbaden, 2010.

For the attendance are knowledge of higher mathematical functions required, especially differential and inte-gral calculation.

Usability of module

This module is mandatory for: Computer Engineering for IoT Systems

Requirements for receiving ECTS credit points

Assessment is performed as written examination (120 minutes). Students need to pass the module examination, which encompasses all contents of the lecture.

ECTS credit points and grading

5 ECTS credits

Frequency of offer / Duration of module

SOMMER	1 semester

Work load

150 h of total work load, from:

- 45 h of presence at lectures/exercises
- 45 h of self-study
- 30 h of exercising tasks at home
- 30 h of preparation and attendance for examination

Modul-No.	732	MA	
Modul name	**Lifecycle Assessment**		
Modul coordinator	Voswinckel, Sebastian		
Title	Lifecycle Assessment		
Title of examination	Lifecycle Assessment		
Course Type / SWS	2 SWS Lecture / 2 SWS Lecture/Exercise		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives

Content:
In order to approach the subject of energy, substance and environmental assessments, knowledge of the associated relationships (politics, economy, society) is necessary. It is not the raw calculation of balances, but the consideration of the correct description of the problem. In this context the setting of system boundaries is important too. In workshops, each lasting 4 hours, students will learn to recognize problems in teams and to provide solutions with the help of assessment tools (knowledge based and software).

1. Recognizing and evaluating environmental issues in the media – workshop
2. Introduction to material flows - workshop
3. Consideration and definition of boundaries - workshop
4. Energy/Substance/Environment assessments - workshop
5. Human-Environment-Future - Workshop to select the examination topic based on current environmental issues

Learning objectives:
Students will be able to recognize environmental connections in texts that do not seem to be related to environmental issues (unit 1).
After the unit 2, students will be able to recognize, classify and evaluate material flows.
Establishing system boundaries is a basic requirement for every life cycle assessment. After the workshop 3, students will know how to set system boundaries correctly.
After the workshop 4, students will be able to create the relevant assessment sheets and read data from sheets that have already been created. Students also got an insight into software for creating these assessments.
After the workshop 5 students have to choose a topic for your scientific work and explained it to the person responsible for the module.

Recommended Literature

For preparation the following international/national standards and scientific books are recommended:

- ISO 14001 Environmental management systems — Requirements with guidance for use
- ISO 14040 Environmental management – Life cycle assessment – Principles and Framework
- ISO 14041 Goal and Scope definition and inventory analysis
- ISO 14042: Environmental management — Life cycle assessment — Life cycle impact assessment
- ISO 14043 Environmental management — Life cycle assessment — Life cycle interpretation
- ISO 14044 Environmental management – Life cycle assessment – Requirements and Guidelines
- DIN EN ISO 14040 Umweltmanagement – Ökobilanz – Grundsätze und Rahmenbedingungen
- DIN EN ISO 14044 Umweltmanagement – Ökobilanz – Anforderungen und Anleitungen
- Klöpffer, W.; Grahl, B.: Ökobilanz (LCA): Ein Leitfaden für Ausbildung und Beruf, Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, 2009, Print ISBN:9783527320431 |Online ISBN:9783527627158
- Frischknecht, R.: Lehrbuch der Ökobilanzierung, Springer Spektrum, 2020.
- Klöpffer, W., Grahl, B.: Ökobilanz (LCA), Wiley-VCH, 2019.

Forms of teaching / Prerequisites for participation

Workshop with Lecture.

There are no formal requirements for participation.

Usability of module

This module is elective for: Computer Engineering for IoT Systems
Requirements for receiving ECTS credit points
Students need to pass the module examination, which encompasses all contents of the lecture. Type of examination written scientific report (10 pages) and Power Point Presentation (15 minutes + 5 minutes Q&A).
ECTS credit points and grading
Modules are assessed by a module examination, which is credited by 5 credit points according to the ECTS (European Credit Transfer and Accumulation System).
Frequency of offer / Duration of module

SOMMER	The module is held within one semester.

Work load
Course Participation = 20 h Preparation and follow-up (of the lecture) = 20 h Preparation for examination = 110 h The entire workload encompasses 150 hours, which equals 5 ECTS credit points.

Modul-No.	755	MA	
Modul name	**Industry 4.0**		
Modul coordinator	Brodhun, Christoph		
Title	Industrie 4.0		
Title of examination	Industry 4.0		
Course Type / SWS	2 SWS Lecture with Lab / 2 SWS Lecture with Lab		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives

Course Description:
The lecture deepens the knowledge regarding the logistical activities within and between companies as well as end users. The following are dealt with in detail:

1. Basics and Trends
2. Definition, Goals, Integration
3. Potentials, Effects, Need for Design
4. Practical Examples

Objectives:
After successful participation in the lecture, the students have a production-specific overview of the subject of Industry 4.0 and Smart Factory. The students know the basic ICT technologies in manufacturing companies. They are familiar with cyber-physical systems (CPS) and radio frequency identification (RFID). They can also transform the benefits from big data analytics into smart data. Upon completion of the learning process, the successful student will be able to answer specific questions about security aspects in data networks including cloud approaches. As part of the Industry 4.0 course, students develop the essential basics of the topic and undertake a critical reflection against the background of data security, workplace development, etc. In addition, seminar presentations convey the essential technology drivers to the students. Building on this knowledge, the students can apply the knowledge they have acquired in form of a publication on the subject of Industry 4.0 in a company. It is important to develop the requirements in order to implement the guiding principles of Industry 4.0 at a medium-sized practice partner and to present this requirements paper to a selected group of employees. The students understand the potential and the degree of complexity of future-oriented production scenarios and they can identify with specific project topics.

Recommended Literature

- Vogel-Heuser, B.; Bauernhansl, T.; Ten Hompel, M.; (Hrsg) (2017): Handbuch Industrie 4.0 Bände 1-4
- Vogel-Heuser, B.; Bauernhansl, T.; Ten Hompel, M.; (Hrsg.) (2014): Industrie 4.0 in Produktion, Automatisierung und Logistik Anwendung Technologien · Migration, Springer, Wiesbaden
- Meinhardt, S.; Pflaum, A. (Hrsg.) (2019): Digitale Geschäftsmodelle Band 2: Geschäftsmodell-Innovationen, digitale Transformation, digitale Plattformen, Internet der Dinge und Industrie 4.0. Wiesbaden : Springer Vieweg, 2019
- Heyse, V. (2018): Mittelstand 4.0 - eine digitale Herausforderung : Führung und Kompetenzentwicklung im Spannungsfeld des digitalen Wandels. Münster : Waxmann, 2018
- https://www.bmbf.de/files/Umsetzungsempfehlungen_Industrie4_0.pdf

Forms of teaching / Prerequisites for participation

Lecture, tutorials, exercises and assignments. The topics are deepened through excursions and discussions. Films, case studies and short presentations complement the lectures.

Bachelor degree & interest to investigate further.

Usability of module

This module is elective for: Computer Engineering for IoT Systems

Requirements for receiving ECTS credit points

35 % written exam 65 % assignments

ECTS credit points and grading	
Modules are assessed by a module examination, which is credited by 5 credit points according to the ECTS	
Frequency of offer / Duration of module	
SOMMER	1 semester
Work load	
150 h of total work load, from: 30h lecture participation (online or in presence) 30h seminar participation (online or in presence) 30h homework & self-study 60h presentation & team work	

Modul-No.	761	MA	
Modul name	**Bussystems in Energy and Sensor Networks**		
Modul coordinator	Hühn, Thomas		
Title	Bussystems in Energy and Sensor Networks		
Title of examination	Bussystems in Energy and Sensor Networks		
Course Type / SWS	2 SWS Lecture / 2 SWS Lab		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives

Inhalt:

- Grundlagen der Adressierung, binäres Zahlensystem, Synchronisation
- Bussysteme: Grundlagen verschiedener Busstrukturen; Sicherheit, Kapazität, Latenz, Kosten, Echtzeitfähigkeit, Energieeffizienz
- Standards: USB-Bus Konzept und Protokollstack (Device, Host, OTG); Smart Grid Bussysteme: Modbus mit Varianten, SCADA, Energiebus; Smart Home Bussysteme: KNX, enOcian, M-Bus; IoT Netze: Bluetooth LowEnergy, LORA, 6LoWPAN, ZigBee, NB-IoT (3GPP)
- Parktische Anwendungen mit embedded Systemen: SmartGrid: PowerQuality EN50160 via USB, Smart Gateways; E-Mobility: Gesteuertes Laden und Entladen, Automotive Ethernet; Industrie 4.0: Cyber Physical Systems
- Herausforderungen von All-IP Netzen und Gatewaykonzepte: Konvergenz; Security in IoT Netzen
- Datenübertragen und Aggregation in Sensornetzwerken (Pub-Sub Konzepte): Publish & Subscribe Protokolle (MQTT)

Lerziele:

Im Rahmen des Moduls „Bussystems in Energy and Sensor Networks“ lernen die Studierenden verschiedene Bussysteme zum Vernetzen von Sensoren und deren Funktionsweise kennen. Der praktische Anwendungsbezug hat den Fokus auf aktuelle Anwendungen aus den Bereichen Smart Grid, e-Mobility und Industrie 4.0.

Recommended Literature

None.

Forms of teaching / Prerequisites for participation

Die Veranstaltung besteht aus der Vorlesung und einem Praktikum mit selbständig zu lösenden Programmieraufgaben. Die Vorlesungsinhalte und Aufgaben werden den Studierenden mittels der e-learning-Plattform der Hochschule zur Verfügung gestellt. Die Vorlesung findet in einem PC-Labor statt, so dass ein praxisnahes Demonstrieren und Lernen möglich ist. Zur Diskussion der Praktikumsaufgaben gibt es zweiwöchentliche Treffen an der Hochschule oder im online-chat-room der e-learning-Plattform der Hochschule um praktische Einsatzszenarien und Anwendungen in produktiven Sensornetzwerken und embedded Systems zu demonstrieren.

Für die Teilnahme bestehen keine formalen Voraussetzungen die über Anforderungen an einen Masterkurs hinausgehen. Von den teilnehmenden Studierenden wird erwartet, dass sie ein grundlegendes Verständnis über Netzwerkprotokolle und -architekturen im heutigen Internet vorhanden ist, als auch grundlegende Programmierkenntnisse. Die begleitend empfohlene Literatur wird in der Einführungsveranstaltung bekannt gegeben

Usability of module

This module is elective for: Computer Engineering for IoT Systems

Requirements for receiving ECTS credit points

Die erfolgreiche Testierung aller Praktikums-Programmieraufgaben ist Prüfungsvoraussetzung. Die Prüfung erfolgt in Form einer schriftlichen Klausur über 60 min. Das Bestehen der schriftlichen Klausur ist Voraussetzung für die Vergabe der Leistungspunkte.

ECTS credit points and grading

The course grade is the grade of the examination.

Frequency of offer / Duration of module	
SOMMER	1 semester
Work load	
Vorlesung mit aktiver Einbeziehung der Studierenden (ca. 45h), Vor- und Nachbereitung des behandelten Stoffes (ca. 45h) sowie Lösung der praktischen Programmieraufgaben (ca. 60h). Die gesamte Arbeitsbelastung umfasst 150h, dies entspricht 5 ECTS.	

Modul-No.	762	MA	
Modul name	**Data Science in Python**		
Modul coordinator	Lustermann, Birgit		
Title	Data Science in Python		
Title of examination	Data Science in Python		
Course Type / SWS	2 SWS Lecture / 2 SWS Exercise/Lab		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives

Objective
This lecture looks at the issue of evaluation of large amounts of data with Python. It encompasses cleansing, manipulating and aggregating data to preparing datasets for further analysis and processing and presenting the results. To achieve the goal of data data science, which is to make predictions that support business decision-making, pattern must be found in the data and the accuracy of these predictions must be verified.

Module content:

1. Introduction to Data Science
2. Anaconda, IPython and Jupyter Notebook - Introduction to tools and development environments.
3. **Fundamentals of Machine Learning - with Scikit-Learn** (regression, classification, training, prediction and verification, support vector machines, decision trees, random forests , dimensionality reduction, unsupervised learning techniques)
4. **Neural Networks and Deep learning - with Keras and Tensorflow** (Introduction in artificial neural networks with Keras, training Deep Neural Networks, custom models with Tensorflow, loading and processing data with Tensorflow)

Learning goals:
After successfully completing the module, students have a deeper knowledge about efficient processing and preparation of large data packages with the help of the Python programming language. To do this, they first familiarise themselves with the necessary software tools. They consolidate the knowledge acquired in the lecture by independently working on complex programming tasks during the practical course. Knowledge is acquired in dealing with Python modules and packages. The functions of the Python packages required for machine learning algorithms are examined in more detail. The application of the Data Science functions is carried out on realistic datasets. The students learn basic terms from the field of machine learning and neural networks and apply selected methods to extract features, detect trends or make estimates of properties.

Recommended Literature

1. Jake Vanderplas: Python Data Science Handbook, O'REILLY, 2016 or
(Python Data Science Handbook | Python Data Science Handbook (jakevdp.github.io))

2. Aurélien Géron: Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, Third Edition

On-line Lecture notes and training material will be available.

Forms of teaching / Prerequisites for participation

Lecture with integrated exercises

course specific requirements:

1. Basic syntax of the Python programming language (data types, structures, functions, classes, modules and packages)
2. Array processing with Numpy (basics)
3. Data processing with Pandas (basics)
4. Visualisation with Matplotlib / Seaborn (basics)

Usability of module

This module is elective for: Computer Engineering for IoT Systems

Requirements for receiving ECTS credit points	
Assessment is performed as a written examination (90 minutes)	
ECTS credit points and grading	
The course grade is the grade of the examination (4 ECTS credits) + machine learning project + (1 ECTS credit)	
Frequency of offer / Duration of module	
JEDES	1 Semester
Work load	
150 h of total work load, from: 45 h of presence at lectures/exercises 55 h of self-study + project preparation 50 h of preparation for examination + exam project	

Modul-No.	780	MA	
Modul name	**Wireless Sensor Networks**		
Modul coordinator	Schölzel, Mario		
Title	Wireless Sensor Networks		
Title of examination	Wireless Sensor Networks		
Course Type / SWS	4 SWS Lecture		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives

Content:

WSNs and their applications and limitations

Hardware and Operating System part:

- Basics of transmission technology and ISM regulations
- Hardware architectures for WSN motes
- Low power techniques in motes
- Operating systems for WSNs

Simulation of WSNs

Protocols for WSNs

- PHY-Layer
- MAC- and WSN MAC state monitoring at the PHY-layer
- routing protocols for WSNs: bable, olsr v1/v2 & batman

Addressing in WSNs

- publish/subscribe

Network topologies and network stacks

- ZigBee
- Linux network stack implementation
- monitore/collect/merge measurement races with open source tools

Objectives:

After successfully passing the lecture, the students know:

- Typicaly applications of wireless sensor networks
- They know the properties of various protocols
- They are able to choose an appropriate hardware base for setting up a wireless sensor network
- They are able to develop low-power applications for wireless sensor networks
- They are able to implement WSN applications for collecting data and transmitting data to a data sink

Recommended Literature

Protocols and Architectures for Wireless Sensor Networks Holger Karl; Andreas Willig, Wiley, ISBN 0-470-09510-5
Distributed Sensor Networks S. Sitharama Iyengar and Richard. R. Brooks, Chapman & Hall/CRC, ISBN 1-58488-383-9
Wireless Sensor Networks, Architectures and Protocols Edgar H. Callaway, Jr, Auerbach Publications ISBN 0-8493-1823-8
Sensor Technology Handbook John S. Wilson, Newnes ISBN 0-7506-7729-5
Ad Hoc Wireless Networks Mohamed Ilyas, CRC Press, ISBN 0-8493-1332-5
Markus Krauße, Rainer Konrad: Drahtlose ZigBee-Netzwerke – ein Kompendium, Springer Vieweg, 2014.
Fred Eady: Hands-On ZigBee – 1st edition, Elsevier, 2007.

Forms of teaching / Prerequisites for participation

Lecture with integrated exercises and labs on selected topics

No course specific requirements.

Usability of module

This module is mandatory for: Computer Engineering for IoT Systems

Requirements for receiving ECTS credit points

Assessment is performed either as written examination (90 minutes) or oral examination. Students need to pass the module examination, which encompasses all contents of the lecture.

ECTS credit points and grading

5 ECTS credits

Frequency of offer / Duration of module

SOMMER	1 semester

Work load

150 h of total work load, from:

- 45 h of presence at lectures/exercises
- 55 h of self-study
- 50 h of preparation for examination

Modul-No.	781	MA	
Modul name	**Dependable System Design**		
Modul coordinator	Schölzel, Mario		
Title	Dependable System Design		
Title of examination	Dependable System Design		
Course Type / SWS	4 SWS Lecture		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives

Content:
The module provides an introduction into techniques, measures, means and standards for designing and developing dependable system:

- Introduction and Terminology: Threats, Means, Meassures
- Fault Models and Fault sources
- Redundancy Concepts and architectures
  - Software-Redundancy
  - Hardware-Redundancy (active/passive)
  - Data Redundancy (error detection codes, error correction codes)
  - Time-Redundancy
- Testing hardware and software
- Modeling and Estimating Reliability and Availability
  - Failure rate
  - Reliability and MTTF
  - Serial-/Parallel Systems
  - RBD, failure-trees
  - Markov-Models
- Functional Safety and ISO 26262

Objectives:
The student has a good knowledge about the terminology for dependability. He knows the threats that affect the dependability of a system negatively as well the means that affect the dependability in a positive way. He can apply these means in different design phases for a dependable systems. By understanding the models for reliability and availability, the student can justify is design choices for increasing reliability and availability. The student is also ware of standards for developing dependable systems, as an example he knows the ISO 26262 for designing electronic automotive systems.

Recommended Literature

Kishor S. Trivedi: Probability and Statistics with Reliability, Queuing and Computer Science Applications (Second Edition). John Wiley & Sons, Inc., 2002.
Dhirak K. Pradhan: Fault-Tolerant Computer System Design. Prentice Hall PTR, 1996.
Isreal Koren and C. Mani Krishna: Fault-Tolerant Systems, Morgan Kaufmann, 2007.
Parag K. Lala: Self-Checking and Fault-Tolerant Digital Design.Morgan Kaufmann, 2001.
Laung-Terng Wang, Cheng-Wen Wu, Xiaoqing Wen (Editors): VLSI test Principles and Architectures. Morgan Kaufmann, 2006.
Abramovici, M. Breuer, M., Friedman, A. „Digital Systems Testing and Testable Design“ Computer Science Press, 1990,

Forms of teaching / Prerequisites for participation

Lecture with integrated exercises

No course specific requirements.

Usability of module

This module is mandatory for: Computer Engineering for IoT Systems

Requirements for receiving ECTS credit points

Assessment is performed either as written examination (90 minutes) or oral examination. Students need to pass the module examination, which encompasses all contents of the lecture.	
ECTS credit points and grading	
5 ECTS credits	
Frequency of offer / Duration of module	
SOMMER	1 semester
Work load	
150 h of total work load, from: • 45 h of presence at lectures/exercises • 55 h of self-study • 50 h of preparation for examination	

Modul-No.	782	MA	
Modul name	**Embedded Software Design and Programming**		
Modul coordinator	Dotsenko, Alexander		
Title	Embedded Software Design and Programm.		
Title of examination	Embedded Software Design and Programming		
Course Type / SWS	4 SWS Lecture		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives

Contents:

The module outlines the challenges of embedded software development and describes the common elements of embedded solutions.

- Fundementals of the C++ programming language
- Quality criteria for embedded software
- Embedded operating systems
- Memory management
- Managing sensors and actuators, technique for communicating with the peripherals
- Using registers
- Task management and scheduling
- Using network interfaces
- Minimizing power consumption
- Test strategies

Learning Objectives:

On successfully completing the module the students will be able

- To contrast the differences between embedded and conventional software requirements and architectures
- To know the architecture of the relevant operating systems including memory management
- To understand the steps involved in controlling physical devices and using networking capabilities
- To implement parallel processes with synchronization
- To develop a test plan for embedded solutions

Recommended Literature

Marwedel, P., Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things. 3rd Ed, 2018, Springer
White, E., Making Embedded Systems, 2011: O'Reilly Media

Forms of teaching / Prerequisites for participation

Lecture with integrated exercises

Prerequisites for the course: a working knowledge of C++ or Java and basic programming skills

Usability of module

This module is mandatory for: Computer Engineering for IoT Systems

Requirements for receiving ECTS credit points

The ECTS credits are awarded after passing the exam.

ECTS credit points and grading

5 ECTS credits	
Frequency of offer / Duration of module	
SOMMER	1 semester
Work load	
in-class learning: 45 h review of lectures and exercises: 30 h self-study: 45 h preparation for the exam: 30 h total work load: 150h	

Modul-No.	783	MA	
Modul name	**Signals and Control**		
Modul coordinator	Viehmann, Matthias		
Title	Signals and Control		
Title of examination	Signals and Control		
Course Type / SWS	4 SWS Lecture		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives

Content:
The objective of this course is to understand the signal types and the fundamentals of sensors, the signal conditioning and the signal processing. Furthermore digital controller will be investigated in simulation and application.

Objectives:
- Signal types, Sensor examples
- Signal conditioning (amplifiers, filter circuits)
- Analog digital converter, digital analog converter
- Digital signal processing
- Digital filter
- Fast Fourier Transformation (FFT)
- Digital controller
- Simulation of control loops

Recommended Literature

Franco, S.: Design with Operational Amplifiers and Analog Integrated Circuits. New York: The McGraw-Hill Companies, 4. Edition, 2015
Viehmann, M.: Operationsverstärker – Grundlagen, Schaltungen, Anwendungen. 2., überarbeitete und erweiterte Auflage. München: Hanser, 2020
Engelberg, S.: Digital Signal Processing. Language: English. ISBN: 1848001185. Springer-Verlag GmbH

Forms of teaching / Prerequisites for participation

Lecture including exercises

No course specific requirements.

Usability of module

This module is mandatory for: Computer Engineering for IoT Systems

Requirements for receiving ECTS credit points

Assessment is performed either as written examination (90 minutes) or oral examination. Students need to pass the module examination, which encompasses all contents of the lecture.

ECTS credit points and grading

5 ECTS credits

Frequency of offer / Duration of module

SOMMER	1 semester

Work load

150 h of total work load, from:
- 45 h of presence at lectures/exercises
- 55 h of self-study

- 50 h of preparation for examination

Modul-No.	784	MA	
Modul name	**Seminar on topics in computer engineering**		
Modul coordinator	Schölzel, Mario		
Title	Seminar on topics in computer engineering		
Title of examination	Seminar on topics in computer engineering		
Course Type / SWS	2 SWS Lecture		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives

Content:
Students prepare a presentation on current topics in computer engineering. The topics and literature are provided from the lecturers of the institute. Provided literature can be a scientific article in a journal or conference proceeding as well as a book chapter, or another scientific publication. The presentation is given in front of the course attendees. The presentation should also include a discussion of the results from the perspective of the student.

Objectives:
The students should learn:

- to read a scientific paper,
- to prepare a well-designed presentation,
- practice a good presentation style, and
- to deal critical with a topic,
- to contribute to a technical group discussion.

Recommended Literature

Michael Alley, The Craft of Scientific Writing, 4th Ed, 2018, Springer
Hofmann, Angelika H, Scientific Writing and Communication: Papers, Proposals, and Presentations, 4th Ed, 2019, Oxford University Press
Wayne C. Booth, The Craft of Research, 4th Ed, 2016, University of Chicago Press

The course also uses changing bibliographic references to technical publications that are provided along with the topics.

Forms of teaching / Prerequisites for participation

Students receive an introductory lecture.
Students prepare during the first ten weeks of the semester the presentation. This includes

- a consultation with the instructor of 30 min about the content of the presentation and
- a consultation with the instructor of 30 min about the presentation style.

The presentation including a discussion with the audience.

No course specific requirements.

Usability of module

This module is mandatory for: Computer Engineering for IoT Systems

Requirements for receiving ECTS credit points

Assessment is performed based on the quality of the prepared material for the consultation and participation in the discussions of other students´ presentations (25 %) and the final presentation itself (75%). The assessment can be partly based on the group results.

ECTS credit points and grading

5 ECTS credits

Frequency of offer / Duration of module	
SOMMER	1 semester

Work load

150 h of total work load, from:

- 20 h of presence for listening/giving the presentation
- 40 hours for reading and understanding the literature
- 90 hours for preparing the presentation and documents for consultation

Modul-No.	786	MA	
Modul name	**Cloud Computing and Big Data**		
Modul coordinator	Dotsenko, Alexander		
Title	Cloud Computing and Big Data		
Title of examination	Cloud Computing and Big Data		
Course Type / SWS	4 SWS Lecture/Exercise		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives

Content:

The module provide an overview of the cloud technology and introduce key concepts of Big Data and most common Big Data tools.

- Cloud concepts and cloud service models
- Overview of the container technology
- Elements of data engineering
- Big data concepts including streaming, partitioning and scaling
- NoSQL databases, BASE transactions
- MapReduce algorithm
- Algorithms and architectures for real-time data processing
- Overview of tools and frameworks for data engineering and visualization
- Scenarios for the use of artificial intelligence and machine learning
- Case studies for cloud-based IoT solutions
- Current trends in cloud computing and outlook for the coming years

Learning Objectives:

On successfully completing the module the students will be able

- To critically assess the need for a cloud solution and select the suitable service model
- To plan cloud deployment strategies
- To identify suitable big data solution for specific requirements
- To contrast traditional and NoSQL databases
- To demonstrate knowledge of modern tools for data collection, cleansing and integration, data visualization

Recommended Literature

Documentation and Tutorials of major cloud service providers.
Kleppmann M., Designing Data-Intensive Applications. 2017, O'Reilly Media
Indrasiri K, Suhothayan S., Design Patterns for Cloud Native Applications, 2021, O'Reilly Media
Modi R., Lee J., Skaria R.. Azure for Architects, 3rd Ed, 2020, Packt Publishing
Eric A. Vanderburgone, CompTIA Cloud+ Certification All-in-One Exam Guide (Exam CV0-003)

Forms of teaching / Prerequisites for participation

Lecture with integrated exercises Assignments with presentation and discussion
No course specific requirements.

Usability of module

This module is mandatory for: Computer Engineering for IoT Systems

Requirements for receiving ECTS credit points

The credit points are awarded upon successful completion of the exam.

ECTS credit points and grading	
5 ECTS credits. The module grade is based on the result of the exam.	
Frequency of offer / Duration of module	
WINTER	1 semester
Work load	
in class teaching: 45 h review of the leactures and exercises: 30 h self-study : 45 h preparation for exam: 30 h 150 h of total work load	

Modul-No.	787	MA	
Modul name	**Embedded Smart Systems**		
Modul coordinator	Schölzel, Mario		
Title	Embedded Smart Systems		
Title of examination	Embedded Smart Systems		
Course Type / SWS	4 SWS Lecture/Exercise		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives

Content:
The module gives an introduction into the design and development of embedded systems that can be tailored to user specific applications. To fulfil this objective, the lectures present an overview of hardware architectures and components and their interconnection. The lectures also teach techniques for modeling HW-/SW-systems and assessing performance and power metrics of such systems:

- HW-Components for embedded systems, their architecture, and their interconnection: General Purpose Processor, Microcontroller, DSP, ASIP, FPGA, ASIC, busses, Memory-Mapped-I/O
- Design approaches and methods: Y-Chart, Top-Down, Bottom-Up, Middle-Out, Hardware-/Software-Codesign
- Power, Performance, and area profiling/estimations
- Methods and tools for synthesis: System synthesis, high-level-synthesis of HW-accelerators, FPGA design synthesis, Software-Synthesis
- Models: communicating processes, KPN, data flow graphs, SDF, Petri nets, state-based models, control flow graphs
- Tools for modeling: Ptolemy, SystemC, SystemC-TLM, FPGA-Design tool

In accompanying exercises and labs on selected topics, students will practice the use of some of the synthesis and modeling tools. They also have to explain their solutions.

Objectives:
After successful completion of the course unit, the students will:
- Know typical components and their interactions for building embedded systems (T2, T3, T6)
- Know and be able to apply models for specifying embedded systems at various levels of abstraction (P4, T1, T5, T8)
- Be able to analyze, estimate and determine power, area and performance parameters of such systems during the design phase (P1, T2, T5)
- Model and develop systems with new hardware accelerators of low and medium complexity in the area of embedded systems (P2, T1, T5)
- Know typical tools for the design and development process (T8)
- Be able to present and discuss their solutions (P3)

Recommended Literature

De Micheli, G.: Synthesis and Optimization of Digital Circuits. – New York: McGraw-Hill, 1994
P. Marwedel: Embedded System Design, Springer, 2004.

Forms of teaching / Prerequisites for participation

Lecture with integrated exercises and selected labs.

No course specific requirements.

Usability of module

This module is mandatory for: Computer Engineering for IoT Systems

Requirements for receiving ECTS credit points

Assessment is performed as a written examination (90 minutes)

ECTS credit points and grading	
The course grade is the grade of the examination.	
Frequency of offer / Duration of module	
SOMMER	1 semester
Work load	
150 h of total work load, from: • 45 h of presence at lectures/exercises • 55 h of self-study • 50 h of preparation for examination	

Modul-No.	788	MA	
Modul name	**IT-System Performance Analysis**		
Modul coordinator	Hühn, Thomas		
Title	IT-System Performance Analysis		
Title of examination	IT-System Performance Analysis		
Course Type / SWS	4 SWS Lecture/Exercise		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives

Course Description:
This lecture is designed to empower students to perform computer systems monitoring, troubleshooting and performance analysis. Based on the Linux communication stack, this course provides a deeper knowledge about the fundamental techniques and tools used to analyse the performance of computer systems and their advantages and disadvantages involved. Students will be introduced to the different concepts of performance debugging, monitoring and statistical analysis by the example of Linux network performance issues triggered in productive Internet Service Provider (ISP) infrastructure.

Objectives:
After completing this course, students will be able to:

- Select appropriate Linux tools to monitor and debug network stack issues across layers
- Define monitoring targets, select valid metrics and account potential sources of error
- Build experimental testbed setups to validate assumptions
- Apply statistical methods to perform data and traffic analysis
  - Histograms, boxplots, time domain aggregation
  - Correlation analysis. (e.g. ANOVA)
- Evaluate passive vs. active performance measurements
- Decentralized monitoring challenges to synchronize and merge measurements
- Setup & coding actual network experiments (C, bash, awk, Python)
- Statistical Data Analysis and visual representation with GNU R

Recommended Literature

- Raj Jain: "The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation, and Modeling", New York, 1991, doi:10.1017/S0731126500010933
- David J. Lilja: “Measuring Computer Performance: A Practitioner's Guide.”, Cambridge, 2000 doi:10.1017/CBO9780511612398

Forms of teaching / Prerequisites for participation

Lecture, tutorials, exercises and assignments.

No course specific requirements

Usability of module

This module is mandatory for: Computer Engineering for IoT Systems

Requirements for receiving ECTS credit points

50 % written exam
50 % assignments

ECTS credit points and grading

5 ECTS credits

Frequency of offer / Duration of module

SOMMER	1 semester
Work load	
150 h of total work load, from: • 60h lecture participation (online or in presence) • 60h experimentation & self-study • 30h exam preparation	

Modul-No.	789	MA	
Modul name	**Scientific Seminar**		
Modul coordinator	Schölzel, Mario		
Title	Scientific Seminar		
Title of examination	Scientific Seminar		
Course Type / SWS	2 SWS Lecture/Exercise		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives

Content:
In small groups, the students prepare a presentation on a current topic in computer engineering and IoT. The topics are provided from the lecturers of the institute. Student have to search and study by their own existing literature on the topic. The presentation is given in front of the course attendees. The presentation should also include a discussion of the results from the perspective of the student.

Objectives:
The students should learn:

- To perform a literature study on a specific topic,
- select the right literature,
- prepare a well-designed presentation,
- practicing reading advanced technical publications, comparing their results and presenting their content.
- To efficiently collaborate in a team.

Recommended Literature

- Glasman-Deal H., Science Research Writing for Non-Native Speakers of English: A Guide for Non-Native Speakers of English, 2009, Imperial College Press
- Thiel D.V., Research Methods for Engineers, 2014, Cambridge University Press
- Michael Alley, The Craft of Scientific Presentations: Critical Steps to Succeed and Critical Errors to Avoid, 2nd Ed, 2011, Springer
- Further specific technical literature to be found by the students as part of the work.

Forms of teaching / Prerequisites for participation

Students receive an introductory lecture.
Students prepare during the first ten weeks of the semester the presentation. This includes

- a consultation of 30 min about the selected papers,
- a consultation of 30 min about the comparison of the paper’s content.

The presentation including a discussion with the audience.

No course specific requirements.

Usability of module

This module is mandatory for: Computer Engineering for IoT Systems

Requirements for receiving ECTS credit points

25 % based on the constructive participation in the discussion to other students´ presentations and the shown ability to efficiently collaborate with the lecturer(s) 75 % based on the quality of the final presentation. Assessment can be partly made based on the group results.

ECTS credit points and grading

5 ECTS credits

Frequency of offer / Duration of module	
WINTER	1 semester

Work load

150 h of total work load, from:

- 20 h of presence for listening/giving the presentation
- 50 hours for preparing the first consultation
- 50 hours for preparing the second consultation
- 30 hours for preparing the presentation

Modul-Nr.	791	MA	
Bezeichnung	**Digital Transformation (ICM 15/16)**		
Verantwortlicher	Schölzel, Mario		
Titel der Lehrveranstaltung(en)	Digital Transformation		
Prüfungsbezeichnung	Digital Transformation		
Lehrformen / SWS	4 SWS Seminar mit Praktikum		
Sprache / CP / Workload	Deutsch	7.0	210
Formale Teilnahmebedingungen	keine		

Inhalte und Qualifikationsziele

Inhalt

Digitale Geschäftsmodelle

- Erlernen der Besonderheiten von digitalen Geschäftsmodellen (z. B. digitale Plattformen, Software-as-a-Service, Freemium, Subscription, Blockchain, Internet-of-Things)
- volkswirtschaftliche Einordnung digitaler Geschäftsmodelle
- Ableitung technischer Anforderungen für digitale Geschäftsmodelle, sowie Diskussion von Erfolgsfaktoren und Herausforderungen bei der Implementierung digitaler Geschäftsmodelle in Unternehmen

Digitales Produktmanagement

- Erstellung von Personas, User Journeys, sowie die Entwicklung von Anforderungen an digitale Produkte (insb. User Stories)
- Erlernen der Entwicklung von Prototypen und der Konzeption von Minimum Viable Products (MVP)

Digitales Management

- Studierende erlernen die Potenziale zur Digitalisierung innerhalb Unternehmen zu identifizieren und Digitalisierungsstrategien zu entwickeln.

Anwendung

- Durchführung eines Digitalprojektes in den fokussierten Schwerpunktbereichen mit einem/mehreren Partnerunternehmen (Vorbereitung, Contracting, Analyse, Konzeptentwicklung
- Erstellung von Prototypen/MVPs oder Implementierungsplans und Präsentation der Ergebnisse beim Auftraggeber)
- Reflexion der Projektarbeit durch Teamcoachings und Erlernen eines professionellen Projektmanagements

Qualifikationsziele

Die Studierenden lernen moderne Konzepte und Methoden der digitalen Transformation in Unternehmen kennen. Hierbei verstehen Studierende digitale Geschäftsmodelle und wenden moderne Methoden des Produktmanagements digitaler Produkte an. Weiterhin analysieren Studierende Prozesse des Unternehmens hinsichtlich der Digitalisierungspotenziale und erlernen Digitalisierungsstrategien zu entwickeln. Innerhalb des Praxisprojektes wenden die Studierenden die erlernten Konzepte im Rahmen eines Praxisprojekts an und führen das Projekt professionell – mit Unterstützung von Teamcoachings – durch. Sie besitzen die Fähigkeit, ein Digitalisierungsprojekt teamorientiert/kooperativ zu planen, zu steuern und kontinuierlich den Projektfortschritt zu reflektieren. Dies umfasst die Aushandlung des Auftrags (Contracting), die Analyse, die Konzeptentwicklung und die kontinuierliche Abstimmung/Anpassung des Projektziels. In diesem Zusammenhang besitzen die Studierenden die Fähigkeit, ihre Projektergebnisse kompetent zu kommunizieren und überzeugende Handlungsempfehlungen zu formulieren.

Literaturempfehlungen

- Keuper, F./Schomann, M./Sikora, L.I./Wassef, R. (Hg.) (2018), Disruption und Transformation Management, Wiesbaden.
- Matzler, K./Bailom, F./Friedrich von den Eichen, S./Anschober, M. (2016), Digital Disruption, München.
- Oswald, G./Krcmar, H. (Hg.) (2018), Digitale Transformation, Wiesbaden.
- Parker, G./van Alstyne, M./Choudary, S.P. (2017), Platform revolution, New York, London.
- Tiwana, A. (2014), Platform ecosystems, Waltham, MA.

Lehr- und Lernformen / Voraussetzung für die Teilnahme

Folienfassung zur Veranstaltung und Teamcoachings. Empfohlene Vorkenntnisse: Grundkenntnisse (Wirtschafts-)Informatik / vorbereitendes Selbststudium über E-Learning Digital Basics
Verwendbarkeit
Dieses Modul ist Wahlpflicht für: Computer Engineering for IoT Systems
Voraussetzungen für die Vergabe von ECTS-Leistungspunkten
Eine mindestens mit ausreichend bestanden Prüfung.
ECTS-Leistungspunkte und Benotung
Mündliche Präsentation der Projektarbeit (40%); Projektbericht und Projektposter (30%); Mündliche Prüfungsleistung über das abgeschlossene Projekt und die Inhalte des Seminars (30%); in die Bewertung fließt zudem das Projektmanagement (Umsetzung der Vorgaben, Beratungsleistung, Prozess) ein.
Häufigkeit des Angebots / Dauer des Moduls

WINTER	1 Semester

Arbeitsaufwand (work load)
Besuch der Lehrveranstaltung (42h) sowie Vor- und Nachbereitung (18h); Projektarbeit (130h); Prüfungsvorbereitung (20h)

Modul-No.	870	MA	
Modul name	**Basics in Electrical Engineering**		
Modul coordinator	Wang, Jiayi		
Title	Basics in Electrical Engineering		
Title of examination	Basics in Electrical Engineering		
Course Type / SWS	2 SWS Lecture / 2 SWS Exercise / 0.5 SWS Lab		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives

Content

Part 1: DC Systems

- Resistances and Temperatures
- Serial and parallel connections Feld
- Voltage & Current Divider
- Kirchhoff's Laws
- Mesh Flow Analyses

Part 2: Single Phase Systems

- Complex Numbers
- Complex Operators
- Simple circuits driven by sinusoidal voltage
- Real, Reactive and Apparent Power
- Power Factor and compensation

Part 3: Three Phase Systems

- Introduction multiphase systems
- Star and Delta connection
- Basics Generators
- Basics Transformers

Learning goals:

The students will get a basic introduction of Electrical Engineering. Part I contains the knowledge to analyze easy circuits, feed by direct voltage. Resistances as a function of the temperature and serial and parallel connections will be treated. Finally Kirchhoff's Laws will be introduced. All contents of part I also can be applied for Part II & III. Complex numbers will be used to deal with sinusoidal functions as a basic procedure.

Part II will be focused to the basic calculation of simple circuits, driven by DC voltage. The meaning of the Power Factor and the apparent power will be clarified.

Part III will be more practical orientated. The students will deal with the multiphase systems and the possibility to connect the systems into Star- or Delta-Connection. Generators and Transformers will be introduced with their practical applications. Complicate calculations etc. will be avoided.

Recommended Literature

Literatur:

- Lecture Scripts will be uploaded
- Sample task will be uploaded

Forms of teaching / Prerequisites for participation

Teaching forms as stated above

There are no formal requirements for participation. Basics in physics, mathematics and mechanics are recommended. Basic

knowledge in thermodynamics, heat transfer and renewable energies is useful. Lecture Scripts will be uploaded and sample task will be uploaded

Usability of module

This module is mandatory for: Computer Engineering for IoT Systems

Requirements for receiving ECTS credit points

Assessment is performed as written examination (90 minutes). Other permissible forms of examination (online, oral, homework, etc.) are possible if they are announced by the person responsible for the module at the beginning of the semester.

ECTS credit points and grading

The grade of the module M870 corresponds to the grade of the exam. With the grading, 5 credit points (ECTS) are awarded.

Frequency of offer / Duration of module

WINTER	1 Semester

Work load

The total workload for this module is 150 hours; this corresponds to 5 ECTS credits. This workload results from the presence at the lectures with an active participation of the students in the (virtual) laboratory (about 45 hours). As part of the self-study, the lecture material should be reworked (about 55 hours). The preparation and execution of the examination is about 50 hours.

Modul-No.	873	MA	
Modul name	**Scientific Practice and Writing**		
Modul coordinator	Wesselak, Viktor Aberle, Alexandra		
Title	A: Scientific Practice B: Scientific Writing		
Title of examination	Scientific Practice and Writing		
Course Type / SWS	4 SWS Lecture		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives

A: Scientific Practice

Contents:

Students are taught the acquisition, evaluation and preparation of technical information as a central working technique in the engineering sciences, both in preparation for their master thesis and for their professional life.

1. What does scientific research mean?
2. Literature research
   Libraries and databases for the engineering sciences - Search techniques - Online search in free and fee-based databases - Content indexing of a library using the example of the University of Applied Sciences Nordhausen - Dealing with thessaurs
3. Technical standards
   Objectives and procedures of technical standardization - National and international standards boards - Researching and reading technical standards
4. Patents and industrial property rights
   Objectives and procedures in industrial property protection – patents, utility models, trademarks and designs - national and international patent organizations – German employee invention law - searching and reading patents - patentability of software
5. Writing of academic texts and lectures
   Presentation and structure - Literature references - Lecture structure - Presentation techniques - Examples of bad practice

Learning goals:

After successful completion of the module, students are able to research scientific or technical information, to procure it and to classify the research results with regard to their completeness and credibility. Furthermore, they are aware of the importance and practice of correct citation.

B: Scientific Writing

Contents:

1. Analysing academic languages: style and register, language structures
2. Elements of writing professional and/or academic texts: writing a paragraph; referencing, citing, quoting
3. Writing different text types: e.g. writing a tender, a quote, report and/or article

Learning goals:

Students have essential theoretical knowledge of writing different types of texts, e.g. typical professional documents. They have knowledge of the linguistic characteristics of the written language English as a scientific language, but also for use in a professional context. Students can gather information from specialised texts and internet sources and produce their own texts on topics relevant to their studies in English. They can deal with primary and secondary sources as well as the usual reference methods and citation styles.

Recommended Literature

1. Griffiths, P. (2007), Scientific Writing, Reading.
2. Macgilchrist, F. (2014), Academic Writing, Paderborn.
3. McCarthy, M. / O'Dell, F. (2011) English Vocabulary in use, Cambridge.
4. McCarthy, M. / O'Dell, F. (2016), Academic Vocabulary in Use, Cambridge, Stuttgart.
5. Oshima, A. / Hogue, A. / Curtis, J. (2020), Longman Academic Writing Series, White Plains, NY.

Forms of teaching / Prerequisites for participation

The module is a lecture with practical exercises and with active participationt of the students. The students apply their knowledge in writing short acedemic texts on a given technical topic.

No course specific requirements

Usability of module

This module is mandatory for: Computer Engineering for IoT Systems

Requirements for receiving ECTS credit points

Prerequisite for the award of credit points is regular course participation and:
A: the successful completion of the academic paper and its timely submission or presentation,
B: written and/or oral examination.

ECTS credit points and grading

The module grade corresponds to the arithmetic mean of the successfully completed examinations in the two parts A and B. With an examination grade of at least 4.0, 2.5 credit points (ECTS) are awarded in each part, with the module grade thus totalling 5 credit points.

Frequency of offer / Duration of module

WINTER	The module must be completed within one semester.

Work load

Participation in both courses (50 h); preparation and follow-up (to the lectures/seminars) (25 h); writing an academic paper in part A (50 h), preparation for examination in part B = 25 h. The entire workload encompasses 150 hours, which corresponds to 5 ECTS credit points.

Modul-No.	908	MA	
Modul name	**German as a Foreign Language I**		
Modul coordinator	Aberle, Alexandra		
Title	German as a Foreign Language I		
Title of examination	German as a Foreign Language I		
Course Type / SWS	4 SWS Seminar		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives

The module consists of 4 SWS and takes the promotion of individual language skills in the context of obtaining a UNIcert certificate into account.

A1.1
Vocabulary: introduction; communication in a very simple manner in relation to everyday needs, place of living, family and friends, hobbies and preferences
Grammar: simple word order; different sentence types (statement, question and command); adjectives; singular and plural nouns; present tense of special verbs; definite and indefinite articles; personal pronouns

A2.1
Vocabulary: communication about one's past and education; showing emotions; expressing advantages and disadvantages
Grammar: sub-clauses (weil, dass, wenn), adjectives (comparative and superlative), preterite forms of modal verbs, reflexive verbs, genitive with names, possessive articles in dative

B1.1
Vocabulary: expressing reasons for preferences and dislikes; arrange/book a holiday; understand announcements; write a comment; express past experiences, describe changes in life; apply for a job/internship; environmental protection
Grammar: Use of Infinitiv mit zu and the verb lassen; subordinate clauses with weil, da and obwohl; prepositions: genitive (trotz and wegen), prepositions used with time (dative and genitive); subordinate clauses with damit and um zu; conjunctive II with modal verbs, sein and haben

Recommended Literature

Bahn, Steve et al.: Kurs DaF A2, Deutsch für Studium und Beruf. Stuttgart: Klett 2024.
Dengler, Stefanie; Paul Rusch, Helen Schmitz and Tanja Sieber: Netzwerk neu A1B1. Klett, 2019.
Dengler, Stefanie; Paul Rusch, Helen Schmitz and Tanja Sieber: Netzwerk neu B1. Klett, 2021.
Jin, Friederike and Ute Voss: Grammatik aktiv: A1 –B1. Üben, Hören, Sprechen. Berlin: Cornelsen, 2023.

Forms of teaching / Prerequisites for participation

Interactive Language Course

Usability of module

This module is a profile module for: Computer Engineering for IoT Systems

Requirements for receiving ECTS credit points

Active seminar participation obligatory

ECTS credit points and grading

ECTS: 5 credit points according to the ECTS (European Credit Transfer and Accumulation System).
Types of examination: written examination (60 min.) and oral examination.
The final grade is the arithmetic mean of the examinations.

Frequency of offer / Duration of module

WINTER	1 Semester

Work load
Participation in the course = 50 h Preparation and follow-up (of the lecture) = 55 h Preparation for examination = 45 h The entire work load encompasses 150 hours, which equals 5 ECTS credit points.

Modul-No.	910	MA	
Modul name	**German as a Foreign Language II**		
Modul coordinator	Aberle, Alexandra		
Title	Deutsch als Fremdsprache II		
Title of examination	German as a Foreign Language II		
Course Type / SWS	4 SWS Seminar		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives

The module consists of 4 SWS and takes the promotion of individual language skills in the context of obtaining a UNIcert certificate into account.

A1.2
Vocabulary: simple and direct communication skills in routine situations; participants understand commonly used expressions related to them directly (personal information, education, shopping and geography)
Grammar: details of time, manner and place; perfect tense of haben and sein; auxiliary and modal verbs; separable and inseparable verbs; nominative and dative nouns and prepositions; imperative forms

A2.2
Vocabulary: enquire: ask for information and direction; express one´s opinion; give recommendations; express apologies, complaints and consequences; ask for a favour; describe a picture in detail
Grammar: indirect questions; conjunctive II (sollte) to give a recommendation; adverbs: deshalb, trotzdem; changing prepositions (dative and accusative); verbs used with dative and accusative; subordinate clauses with als and wenn; verbs with fixed prepositions; indefinite pronouns

B1.2
Vocabulary: understand and describe relationships; discuss/solve conflict situations; offer, accept and/or reject help; participate in a discussion; selective reading (finding key words in articles); descriptions of people and processes
Grammar: Plusquamperfekt; subclauses used with time (bevor, bis, nachdem, seit, während); sentence structure (use of nicht); the passive voice (Präsens, Präteritum, Perfekt and modal verbs); adjectives used as nouns, articles used as pronouns (irgendein/-eine/-welche); sentences with je..., desto/umso...; use of participle I and II as adjectives

Recommended Literature

Bahn, Steve et al.: Kurs DaF A2, Deutsch für Studium und Beruf. Stuttgart: Klett 2024.
Dengler, Stefanie; Paul Rusch, Helen Schmitz and Tanja Sieber: Netzwerk neu A1B1. Klett, 2019.
Dengler, Stefanie; Paul Rusch, Helen Schmitz and Tanja Sieber: Netzwerk neu B1. Klett, 2021.
Jin, Friederike and Ute Voss: Grammatik aktiv: A1 –B1. Üben, Hören, Sprechen. Berlin: Cornelsen, 2023.

Forms of teaching / Prerequisites for participation

Interactive Language Course

Usability of module

This module is a profile module for: Computer Engineering for IoT Systems

Requirements for receiving ECTS credit points

Active seminar participation obligatory

ECTS credit points and grading

ECTS: 5 credit points according to the ECTS (European Credit Transfer and Accumulation System).
Types of examination: written examination (60 min.) and oral examination.
The final grade is the arithmetic mean of the examinations.

Frequency of offer / Duration of module

SOMMER	1 Semester
Work load	
Participation in the course = 50 h Preparation and follow-up (of the lecture) = 55 h Preparation for examination = 45 h The entire work load encompasses 150 hours, which equals 5 ECTS credit points.	

Modul-No.	912	MA	
Modul name	**Technical English I**		
Modul coordinator	Aberle, Alexandra		
Title	Technical English I		
Title of examination	Technical English I		
Course Type / SWS	2 SWS Seminar		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives
Topics in Technical English I include materials engineering and properties, tools and equipment, general chemistry as well as mechanics. Language skills encompass selected chapters of grammar for language correctness, reading comprehension and writing skills (reports and instructions). With the acquired skills, students can follow presentations and understand written texts on scientific issues as well as describe technical processes. In doing so, they use appropriate terminology from the fields of engineering as well as adequate grammatical structures. They understand manuals and can give instructions in written form.
Recommended Literature
Bonamy, David: Technical English, Pearson 2022. Ibbotson, Mark: Cambridge English for Engineering, Cambridge 2008. Murphy, Raymond: English Grammar in Use, Cambridge, current edition.
Forms of teaching / Prerequisites for participation
Participation in placement test as a pre-requisite. Active seminar participation required.
Usability of module
This module is a profile module for: Computer Engineering for IoT Systems
Requirements for receiving ECTS credit points
Students need to pass the module examination, which encompasses all contents of the language course. Types of examination: written examination (60 min.) and oral examination (15 min.). Alternative types of examination are possible.
ECTS credit points and grading
Modules are assessed by a module examination, which is credited by 5 credit points according to the ECTS (European Credit Transfer and Accumulation System). The final grade results from the arithmetic mean of the partial performances.
Frequency of offer / Duration of module

WINTER	The module is performed and must be completed within one semester.

Work load
Participation in the course = 50 h Preparation and follow-up (of the lecture) = 55 h Preparation for examination = 45 h The entire work load encompasses 150 hours, which equals 5 ECTS credit points.

Modul-No.	914	MA	
Modul name	**Technical English II**		
Modul coordinator	Aberle, Alexandra		
Title	Technical English II		
Title of examination	Technical English II		
Course Type / SWS	2 SWS Seminar		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives
Topics include Materials Sciences and Chemistry, Environmental Sciences and Ecology, Process Engineering (bio/chem/mech), lab reports and analyses. Language skills encompass reading comprehension, giving instructions, giving presentations, explaining processes, referring to plans and structural design and various aspects of the English grammar (e.g. passive voice, conditionals, modal verbs, adverbs and adjectives). Endowed with these skills, students describe scientific issues and technical processes. They use appropriate terminology from the fields of academia and engineering as well as grammatical structures. They can give instructions in oral and written form and hold scientific presentations.
Recommended Literature
Bonamy, David: Technical English, Pearson 2022. Ibbotson, Mark: Cambridge English for Engineering, Cambridge 2008. Murphy, Raymond: English Grammar in Use, Cambridge, current edtion.
Forms of teaching / Prerequisites for participation
Prerequisite: participation in placement test. This module only applies to students with mother tongue German. Active seminar participation required.
Usability of module
This module is a profile module for: Computer Engineering for IoT Systems
Requirements for receiving ECTS credit points
Students need to pass the module examination, which encompasses all contents of the lecture. Type of examination: written examination (60 min.) and oral examination with a duration (30 min). Alternative types of examination are possible.
ECTS credit points and grading
Modules are assessed by a module examination, which is credited by 5 credit points according to the ECTS (European Credit Transfer and Accumulation System).
Frequency of offer / Duration of module

SOMMER	The module is performed and must be completed within one semester.

Work load
Participation in the course = 50 h Preparation and follow-up (of the lecture) = 55 h Preparation for examination = 45 h The entire work load encompasses 150 hours, which equals 5 ECTS creditpoints.

Modul-No.	940	MA	
Modul name	**Master Thesis CES**		
Modul coordinator	Schölzel, Mario		
Title	A: Master Thesis B: Presentation and Defense		
Title of examination	Master Thesis CES		
Course Type / SWS			
Language / CP / Workload	English	30.0	900
Requirements for attendance	no		

Content and objectives

Content:
A: Master Thesis:
With the master thesis the students develop an independent scientific work. The results are usually derived from the practical activity to a given topic in a company or in another enterprise of professional scientific experience.

B: Presentation and Defence
In the Colloquium, students should present the results of their master thesis in an oral presentation and answer the questions of the supervisors and the audience.

Learning goals:
By completing the master thesis module, the students prove their professional qualification, to solve a practice-relevant engineering problem within a given time limit independently and with scientific methods, to present the results succinctly in a professional manner and to defend it in a colloquium.

Recommended Literature

There are no specific literature recommendations for this module

Forms of teaching / Prerequisites for participation

A: Preparation of a scientific work supervised by an examiner of the university and a supervisor of the company/enterprise
B: Independent presentation of the results during a colloquium

A: The requirements are documented in §21 of the examination regulations.
B: The requirements are documented in §23 of the examination regulations.

Usability of module

This module is mandatory for: Computer Engineering for IoT Systems

Requirements for receiving ECTS credit points

A: Assessment is performed with an at least sufficient graded master thesis.
B: Assessment is performed with an at least sufficient graded colloquium.

ECTS credit points and grading

A: 26 ECTS credits
B: 4 ECTS credits

Frequency of offer / Duration of module

JEDES	1 Semester

Work load

The total workload for this module is 900 hours; this corresponds to 30 ECTS credits. This workload results mainly from the independent and self-responsible handling of the master thesis project (700 hours), the preparation of the master thesis (100 hours) and the presentation (100 hours).

Modul-No.	1013	MA	
Modul name	**Mechatronic Systems**		
Modul coordinator	Neitzke, Klaus-Peter		
Title	Mechatronic Systems		
Title of examination	Mechatronic Systems		
Course Type / SWS	4 SWS Lecture/Exercise		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives

Content:
Students understand the structure of mechatronic systems. They learn the system technology principles and the function of the building blocks (subsystems). They understand how different types of actuators and sensors work.

Objectives:

- Structure and operating principles of mechatronic systems
- Mechatronic sensors
- Mechatronic actuators
- Signal conditioning and transmission
- Processor technology and computer science
- Communication technology and networking
- Regulators and controls
- Actuators and drive systems
- Power supply and power control
- Basic structural elements

Recommended Literature

Klaus Janschek: Mechatronic Systems Design. Springer Text book
Rolf Isermann: Mechatronic Systems. Springer Text book

Forms of teaching / Prerequisites for participation

Lecture with integrated exercises.

No course specific requirements.

Usability of module

This module is elective for: Computer Engineering for IoT Systems

Requirements for receiving ECTS credit points

The assessment is performed as written examination (120 minutes). Students need to pass the module examination, which encompasses all contents of the lecture.

ECTS credit points and grading

5 ECTS credits

Frequency of offer / Duration of module

WINTER	1 semester

Work load

150 h of total work load, from:

- 45 h of presence at lectures/exercises
- 55 h of self-study
- 50 h of preparation for examination

Modul-No.	1024	MA	
Modul name	**IT-Service Management**		
Modul coordinator	Dotsenko, Alexander		
Title	IT-Service Management		
Title of examination	IT-Service Management		
Course Type / SWS	3 SWS Lecture / 1 SWS Seminar		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives

Aims:

- The module aims to provide students with the knowledge of common IT management frameworks and stand-ards.

Outline of Syllabus:

- The role of Information Systems
- Overview of the ITIL framework
- Planning, Implementation and Optimization of transition services
- COBIT, Prince2, CMMI
- Impact of emerging technologies
- Fundamentals of IT security management
- International standards relevant to IT service management
- Current tools for IT service management

Learning Objectives:

Upon successfully completing the module the students shall

- be able to plan and assess IT services using proven industry tools
- be able to choose an appropriate IT management methodology and to justify the decision
- know the common internation standards regarding cybersecurity and software operations
- understand the business implications of IT design and development methodologies.

Recommended Literature

- J. Sansbury, E. Brewster, A. Lawes, R. Griffiths, IT Service Management, 3rd Edition, BCS, The Char-tered Institute for IT, 2016
- C. Bentley , The Concise PRINCE2® - Principles and Essential Themes, 3rd Edition, IT Governance Publishing, 2019
- C. Agutter, ITIL® Foundation Essentials – ITIL 4 Edition - The ultimate revision guide, IT Governance Publishing, 2019

Forms of teaching / Prerequisites for participation

Lectures and Case Studies

No course specific prerequisites

Usability of module

This module is mandatory for: Computer Engineering for IoT Systems

Requirements for receiving ECTS credit points

The credits will be awarded to students who successfully pass the exam.

ECTS credit points and grading

The exam grade is the grade of the module. 5 ECTS credit points will be awarded to the students who successfully passed the exam.	
Frequency of offer / Duration of module	
WINTER	1 Semester
Work load	
150 h of total work load 45 h of classroom teaching (lectures and workshops) 30 h of review and preparation for classroom teaching 45 h of self-study 40 h of preparation for exam	

Modul-No.	8000	MA	
Modul name	**Study success and career progression**		
Modul coordinator	Aberle, Alexandra		
Title	Study success and career progression		
Title of examination	Study success and career progression		
Course Type / SWS	2 SWS Seminar		
Language / CP / Workload	English	5.0	150
Requirements for attendance	no		

Content and objectives
A: Students are familiar with the formal and legal aspects of being a student at a German university embodying requirements, enrolment processes as well as examination regulations, master thesis, finals and colloquium/defence. They know how to plan and structure learning routines successfully. This includes time-management, meeting tight deadlines, avoiding procrastination, progression control and learning intervals. Students manage to prepare for examinations and identify special types of examinations and their requirements. They use personalized strategies for memorizing, reviewing and testing knowledge as well as self-evaluation, motivation and stress reduction. B: Students are familiar with work and working conditions (dos and don´ts) in Germany. They are aware of important regulations and the legal German framework. They are able to apply for jobs or internships in Germany and know the contents of the relevant documents (CV, cover letter etc.), application strategies and processes. Students master typical interview situations and are able to talk about personal qualities, career skills and achievements.
Recommended Literature
Bosewitz, Annette und René (2022). Erfolgreiche Vorstellungsgespräche auf Englisch, Haufe. Bosewitz, Annette und René (2021). Professionell bewerben auf Englisch. Haufe. Bowler, Jade (2021). The Only Study Guide You'll Ever Need: Simple tips, tricks and techniques to help you ace your studies and pass your exams! Blink Publishing. Laufer, Coley (2015). Conquering Exams, Never Fail Exams Again. CreateSpace Independent Publishing Platform.
Forms of teaching / Prerequisites for participation
Seminar: face-to-face teaching, speaking and writing practices and group-work activities
Usability of module
This module is elective for: Computer Engineering for IoT Systems
Requirements for receiving ECTS credit points
Students need to pass both parts of the module examination in order to acquire ECTS. Part A: Oral exam/presentation (30 mins). Part B: Written examination (60 min.). The final grade is the arithmetic mean of the examinations. Active seminar participation is obligatory.
ECTS credit points and grading
The module is assessed by a module examination, which is credited by 5 credit points according to the ECTS (European Credit Transfer and Accumulation System).
Frequency of offer / Duration of module

WINTER	1 semester

Work load
Participation in the course = 60 h, preparation and follow-up = 50 h, preparation for examination = 40 h. The entire work load encompasses 150 hours, which equals 5 ECTS credit points.