Universität Bremen

Faculty 1 Physics/Electrical Engineering

Summersemester 26

Module Guide

for the study of

Control, Microsystems, Microelectronics

Masterstudiengang

valid in connection with the examination regulations MPO v. 04.12.2019

This module guide details the contents of the master's programmes CIT and CMM for informational purposes. Binding rules are set out by the specific examination regulations.

Generated: February 17, 2026

Index by areas of study

1) CMM Compulsory Modules (66 CP)

Students accumulate 66 credit points (including Lab1 and Lab2) plus 30 credit points for the Master Thesis.

a) CMM Compulsory Electrive Modules

Students select two labs from this catalogue.

2) CMM Elective Modules (24 CP)

Students accumulate 24 CP in elective modules from semester 1 through 3.

a) CMM Further Electrive Modules

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3) *** MGnew *** (30 CP)

4) Additional Courses

Module 01-ET-MA-DDsy: Praktikum Entwurf digitaler Systeme / Laboratory Design of Digital Systems

Laboratory Design of Digital Systems

Assignment to areas of study:

- CMM Compulsory Modules / CMM Compulsory Electrive Modules
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:

Mastering algebraic methods of digital technology, Boolean algebra and circuit reduction methods

Learning content:

- Logic syntheses using the Synopsis-Framework
- Layout syntheses using the Cadence-Framework
- Verification of digital systems
- Design-for-Test
- Design of functional blocks, testing of sub-modules and system integration

A list of references will be provided at the start of the semester.

Learning outcomes / competencies / targeted competencies:

Students

- acquire basic knowldege of methods used in CAD-tools for automated design of digital systems
- learn special skills to realize function-specific digital modules and complex circuits

Calculation of student workload:

34 h Self-study
28 h Preparation / follow-up work
28 h SWS / presence time / working hours

Are there optional courses in the modules?

no

Language(s) of instruction:

English / German

Responsible for the module:

Prof. Dr.-Ing. Alberto Garcia-Ortiz

Frequency:

summer semester, yearly

Duration:

1 semester[s]

The module is valid since / The module is valid until:

SoSe 24 / -

Credit points / Workload:

3 / 90 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Portfolio (AT § 8 Abs. 8)

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English / German

Description:
Anzahl Studienleitstungen: 1

Module courses

Course: Praktikum Entwurf digitaler Systeme

Frequency:
summer semester, yearly

Language(s) of instruction:
English / German

Contact hours:
0,00

Literature:
Literatur zum Modul wird in den jeweiligen Veranstaltungen bekanntgegeben.

Teaching format(s):
Laboratory class

Associated module examination:

Module 01-ET-MA-Entec: Praktikum Energietechnik / Laboratory Energy Engineering

Laboratory Energy Engineering

Assignment to areas of study:

- CMM Compulsory Modules / CMM Compulsory Electrive Modules
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:

Basics in power electronics and drive, basics in power systems

Learning content:

6 experimental simulations with PowerFactory:

- Network calculation
- Asynchronous generators
- Optimal Power Flow, Economical Dispatch
- Decentralized energy resources
- Stability aspects of synchronous generators
- Protection

Learning outcomes / competencies / targeted competencies:

Students will be able to combine the contents of the energy-related lectures from the Master's programmes in Renewable Energies, Automation Technology and CMM with their own experimental experience.

Calculation of student workload:

24 h Self-study
48 h Preparation / follow-up work
18 h SWS / presence time / working hours

Are there optional courses in the modules?

no

Language(s) of instruction:

English / German

Responsible for the module:

Prof. Dr.-Ing. Johanna Myrzik

Frequency:

winter semester, yearly

Duration:

1 semester[s]

The module is valid since / The module is valid until:

SoSe 24 / -

Credit points / Workload:

3 / 90 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Portfolio (AT § 8 Abs. 8)

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English / German

Description:
Anzahl Studienleistungen: 1

Module courses

Course: Entec - Laboratory Energy Engineering

Frequency:
winter semester, yearly

Language(s) of instruction:
German

Contact hours:
2,00

Teaching format(s):
Laboratory class

Associated module examination:
Modulprüfung

Module 01-ET-MA-LRT: Praktikum Regelungstechnik / Advanced Control Lab
Advanced Control Lab

Assignment to areas of study:
- CMM Compulsory Modules / CMM Compulsory Electrive Modules
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
Lecture "Control Theory I"

Learning content:
- Crane: Modelling, analysis, and state space control (pole placement method) of a crane
- Inverted pendulum I: Swinging up of an inverted pendulum using different methods
- Inverted pendulum II: Modelling, analysis, and state space control (pole placement method) for the stabilization of an inverted pendulum
- Helicopter: Modelling, analysis, and state space control (Riccati method) of a helicopter model
- Identification and control with an industrial plant control system

References:

- Michels, K.: Script „Control Engineering“ (German and English)
- Scripts for each experiment are available in German and English

Learning outcomes / competencies / targeted competencies:
The students shall get experience with the design and practical application of complex controllers.

Calculation of student workload:
75 h Preparation / follow-up work
15 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
German / English

Responsible for the module:
Prof. Dr.-Ing. Kai Michels

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
3 / 90 hours

This module is ungraded!

Module examinations

Module examination: Praktikum Regelungstechnik

Type of examination: module exam

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
yes

Number of graded components / ungraded components / prerequisites of the examination:
- / 1 / -

Language(s) of instruction:
English / German (Ein detailliertes Laborskript liegt auf Deutsch und Englisch vor / A detailed script in German and English is available)

Module courses

Course: Praktikum Regelungstechnik

Frequency:
summer semester, yearly

Language(s) of instruction:
German

Contact hours:
2,00

Teaching format(s):
Laboratory class

Associated module examination:
Praktikum Regelungstechnik

Module 01-ET-MA-MMK: Praktikum Mikroelektronik / Laboratory Design of Microelectronics

Laboratory Microelectronics

Assignment to areas of study:

- CMM Compulsory Modules / CMM Compulsory Electrive Modules
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:

Lecture "Integrated Circuits"

Learning content:

- Matlab modelling of systems
- Circuit simulation, synthesis, digital layout
- Analog design by gm/id method
- Layout of analog circuits
- Mixed-signal chip design

Practical use of state-of-the-art industrial CAD design tools (Cadence, Synopsys, Mentor)**;** Groups up to 3 students.

Learning outcomes / competencies / targeted competencies:

Students shall get basic experience of methods for the design of analog and mixed signal integrated circuits using industrial CAD tools starting from a system level specification. Students learn special skills from verification, circuit simulation, synthesis, device sizing down to first steps for layout.

References:

- Michael John Sebastian Smith, Application-Specific Integrated Circuits, Addison-Wesley Publishing Company ISBN 0-201-50022-1
- Charles Stroud, Nur Touba und Laung-Terng Wang, System-On-Chip Test Architectures: Nanometer Design for Testability, ISBN-10: 012373973X
- Laung-Terng Wang, Cheng-Wen Wu, Xiaoqing Wen, VLSI Test Principles and Architectures: Design for Testability, ISBN: 978-0-12-370597-6

Calculation of student workload:

34 h Self-study
28 h Preparation / follow-up work
28 h SWS / presence time / working hours

Are there optional courses in the modules?

no

Language(s) of instruction:

German / English

Responsible for the module:

Prof. Dr.-Ing. Steffen Paul

Frequency:

summer semester, yearly

Duration:

1 semester[s]

The module is valid since / The module is valid until:

SoSe 24 / -

Credit points / Workload:

3 / 90 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Portfolio (AT § 8 Abs. 8)

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
German / English

Description:
Anzahl Studienleistungen: 1

Module courses

Course: Praktikum Mikroelektronik

Frequency:
summer semester, yearly

Language(s) of instruction:
German / English

Contact hours:
0,00

Literature:
Literatur zum Modul wird in den jeweiligen Veranstaltungen bekanntgegeben.

Teaching format(s):
Laboratory class

Associated module examination:
Modulprüfung

Module 01-ET-MA-MiSP: Praktikum Mikrosystemtechnik (Laboratory Microsystems)
Laboratory Microsystems

Assignment to areas of study:
- CMM Compulsory Modules / CMM Compulsory Electrive Modules
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
none

Learning content:
- Introduction to microtechnology
- Clean room technology, quality standards in clean room, processing
- Fabrication of a sensor in the clean room
- Characterization of the sensor

Group up to 12 students. Short examination of the preparation before the experiment.

Learning outcomes / competencies / targeted competencies:
The students
- know how to conduct in a clean room environment;
- can work with process equipment;
- obtain experience with micro technology;
- can characterize a sensor element.

Calculation of student workload:
28 h SWS / presence time / working hours
20 h Self-study
42 h Preparation / follow-up work

Are there optional courses in the modules?
no

Language(s) of instruction:
English / German

Responsible for the module:
Prof. Dr.-Ing. Michael Vellekoop

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
3 / 90 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Portfolio (AT § 8 Abs. 8)

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English / German

Description:
Anzahl Studienleistungen: 1

Module courses

Course: Praktikum Mikrosystemtechnik

Frequency:
winter semester, yearly

Language(s) of instruction:
English / German

Contact hours:
2,00

Teaching format(s):
Laboratory class

Associated module examination:
Modulprüfung

Module 01-ET-MA-SCL: Laboratory Sensor Characterization
Sensor Characterization Laboratory

Assignment to areas of study:
- CMM Compulsory Modules / CMM Compulsory Electrive Modules
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
Modul 01-ET-MA-SAMS(a): Sensors and Measurement Systems

Learning content:
A thermal sensor for infrared radiation (thermopile) is analyzed. The sensor is exposed to different thermal radiation of varying intensity. Sensitivity, time constant and noise are evaluated.

Groups up to 6 students. Short examination of the preparation before the experiment.

Learning outcomes / competencies / targeted competencies:
Students will learn how to:

- Plan and document experiments
- Write a scientific report
- Communicate measurement data

Calculation of student workload:
90 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr.-Ing. Björn Lüssem

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
3 / 90 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Portfolio (AT § 8 Abs. 8)

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English

Description:
Anzahl Studienleistungen: 1

Module courses

Course: Laboratory Sensor Characterization

Frequency:
(depending on capacity) winter or summer semester

Language(s) of instruction:
English

Contact hours:
2,00

Teaching format(s):
Laboratory class

Associated module examination:
Modulprüfung

Module 01-ET-MA-ADS(a): Advanced Digital System Design
Advanced Digital System Design

Assignment to areas of study:
- CMM Compulsory Modules

Content-related prior knowledge or skills:
Knowledge in fundamental digital modules and their use in electronic systems. Ability to implement digital modules according to the state of the art.

Learning content:
Multiprocessors

- Taxonomy
  SIMD architectures
  Shared memory vs message passing multiprocessors

Data coherency in multiprocessor systems

- Cache architectures
- Snooping-protocols

Interconnect architectures

- Metrics and topologies
- On-Chip buses
- Networks-on-Chip

A list of references will be provided in the respective courses.

Learning outcomes / competencies / targeted competencies:
- Relevant skills for the realization of function-specific digital systems, including high-performance processors
- Knowledge in the systematic construction and the design of a digital system
- Ability to design and analyse digital systems with multiple processors

Calculation of student workload:
56 h SWS / presence time / working hours
56 h Preparation / follow-up work
68 h Exam preparation

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr.-Ing. Alberto Garcia-Ortiz

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English / German

Description:
Anzahl der Prüfungsleistungen: 1.

Module courses

Course: Advanced Digital System Design

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
4,00

Literature:
A list of references will be provided in the respective courses.

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung

Associated module courses

Advanced Digital System Design (Lecture)

Advanced Digital System Design (Lecture)

Module 01-ET-MA-BiM: BioMEMS
BioMEMS

Assignment to areas of study:
- CMM Compulsory Modules

Content-related prior knowledge or skills:
none

Learning content:
- Organisation, introduction, basics of microfluidics and BioMEMS
- Flow control: valves and pumps
- Sensors and analysis in BioMEMS devices
- Technology and packaging
- Examples of BioMEMS devices
- Modeling and simulation of microfluidic structures

A list of references will be provided at the start of the semester.

Learning outcomes / competencies / targeted competencies:
An overview is given of the developments in the area of microfluidic and BioMEMS devices from the early start (where especially silicon integrated valves and pumps were investigated) to the lab-on-a-chip devices of today. The functionality of the sensors and actuators, the technologies applied, and the design of fluidic chips will be discussed. Some basic fluidics aspects will be presented and a practical in which COMSOL is used for the simulation of microfluidic elements is included. A series of examples of currently investigated BioMEMS devices will be shown, e.g. chips for capillary electrophoresis, cytometry and optofluidics.

After this course, students are able to:

- understand the basics of microfluidics,
- understand and explain the functioning of µfluidic devices,
- apply characterization parameters for (elements of) µfluidic and BioMEMS devices,
- understand fabrication technologies for microfluidic and BioMEMS devices.

Calculation of student workload:
28 h Self-study
68 h Exam preparation
28 h Preparation / follow-up work
56 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr.-Ing. Michael Vellekoop

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English

Description:
Anzahl Prüfungsleistungen: 1

Module courses

Course: BioMEMS

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
4,00

Literature:
A list of references will be provided at the start of the semester.

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung

Associated module courses

BioMEMS (Lecture)

BioMEMS (Lecture)

Module 01-ET-MA-CTh1(a): Control Theory 1 / Regelungstheorie 1
Control Theory 1

Assignment to areas of study:
- CMM Compulsory Modules

Content-related prior knowledge or skills:
Vorlesung Grundlagen der Regelungstechnik

Learning content:
- Definition und Eigenschaften von Zustandsvariablen / Definition and features of state variables
- Zustandsdarstellung linearer Systeme / State space description of linear systems
- Normalformen / Normal forms
- Koordinatentransformation / Coordinate transformation
- Allgemeine Lösung der linearen Zustandsgleichung / General solution of a linear state space equation
- Lyapunov-Stabilität / Lyapunov stability
- Steuerbarkeit und Beobachtbarkeit / Controllability and observability
- Stationäre Genauigkeit von Zustandsreglern / Steady-state accuracy of state space controllers
- Beobachter / Observer
- Polvorgabeverfahren / Pole Placement controller design
- Riccati-Regler / LQR controllero
- Falb-Wolovitch-Regler / Falb-Wolovitch controller

References:
- K. Michels: Regelungstechnik / Control Engineering (Detailed script in German and English)

German:
- J. Lunze: Regelungstechnik 2
- O. Föllinger: Regelungstechnik
- H. Unbehauen: Regelungstechnik II

English:
- Norman S. Nise: Control Systems Engineering

Learning outcomes / competencies / targeted competencies:
- Sicherer Umgang mit der Zustandsraum-Methodik / Handling of state space methodology
- Entwurf von Zustandsreglern / Design of state space controllerso
- Entwurf von Beobachtern / Observer design

Calculation of student workload:
56 h Preparation / follow-up work
68 h Exam preparation
56 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
English / German

Responsible for the module:
Prof. Dr.-Ing. Kai Michels

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English / German

Description:
Anzahl Prüfungsleistungen: 1

Module courses

Course: Control Theory 1

Frequency:
winter semester, yearly

Language(s) of instruction:
English / German (Ein detailliertes Vorlesungsskript liegt auf Deutsch und Englisch vor / A detailed script in German and English is available)

Contact hours:
4,00

Literature:
K. Michels: Regelungstechnik / Control Engineering (Detailed script in German and English)

Ein detailliertes Vorlesungsskript liegt auf Deutsch und Englisch vor / A detailed script in German and English is available.

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung

Associated module courses

Control Theory 1 (Lecture)

Module 01-ET-MA-InS(a): Integrated Circuits
Integrated Circuits

Assignment to areas of study:
- CMM Compulsory Modules

Content-related prior knowledge or skills:
none

Learning content:
- Noise
- gm/Id Method
- Mismatch
- Two-pole opamps (OTA)
- Feedback

A list of references will be provided at the start of the semester.

Learning outcomes / competencies / targeted competencies:
After this course, students are able to:

- describe and characterize noise in electronics circuits,
- apply the gm/Id sizing method to design amplifier circuits for advance CMOS technologies,
- deal with process variations and mismatch,
- understand the frequency behaviour of amplifier circuits,
- understand and size compensation networks,
- use feedback to modify circuit characteristics.

Calculation of student workload:
68 h Exam preparation
56 h SWS / presence time / working hours
56 h Preparation / follow-up work

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr.-Ing. Steffen Paul

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English

Description:
Anzahl Prüfungsleistungen: 1

Module courses

Course: Integrated Circuits

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
4,00

Literature:
A list of references will be provided at the start of the semester.

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung

Associated module courses

Integrated Circuits (Lecture)

Integrated Circuits (Lecture)

Module 01-ET-MA-LC(a): Language Course
Language Course

Assignment to areas of study:
- CMM Compulsory Modules

Content-related prior knowledge or skills:
none

Learning content:
Depending on their command of the German language students select basic or intermediate language classes. The German language course is organized by Fremdsprachenzentrum Bremen (FZHB) and taught by the Goethe Institute Bremen using the methods of language teaching. The course is mandatory. The students are asked to approach the master office CIT/CMM for details. The courses are advertised in the online course catalogue and on the web pages of FZHB at the start of each semester.

Learning outcomes / competencies / targeted competencies:
The aim of the (German) language course is to achieve a basic understanding of German. After the course, the students should be able to communicate in German for the needs of everyday life. They should also be able to understand scientific and management topics so that they can follow the discussions in a research institute.

Students with German as mother tongue or German language skills corresponding to level C1 approach their examination board to asses their individual requirements.

Calculation of student workload:
56 h SWS / presence time / working hours
124 h Preparation / follow-up work

Are there optional courses in the modules?
no

Language(s) of instruction:
German

Responsible for the module:
Prof. Dr.-Ing. Walter Lang

Frequency:
each semester

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
German

Description:
Gemäß MPO-CIT-02-22 und AeO_MSc-CIT02-22 und MPO-CMM-02-22 und AeO_MSc-CMM-02-22 = Anzahl Studienleistungen: 1.

Module courses

Course: Language Course

Frequency:
winter semester, yearly

Language(s) of instruction:
German

Contact hours:
-

Teaching format(s):
Language learning course

Associated module examination:
Modulprüfung

Associated module courses

Sprachkurs Deutsch / German Language Course ()

Module 01-ET-MA-PAut(a): Process Automation in Power Grids
Process Automation in Power Grids

Assignment to areas of study:
- CMM Compulsory Modules

Content-related prior knowledge or skills:
none

Learning content:
- Basics on process automation operation and control principles
- Sensor and actuators
- Power electronic interfaces
- Programming logic controllers
- Process automation in electrical power systems
- Data and field components
- Network operation principles

Learning outcomes / competencies / targeted competencies:
This lecture on process automation is an independent one-semester course which will give you a basic knowledge in the wide field of process automation. After the course you will be able to understand the basic structures, operation and control principles of automation processes. You will understand the working principle of the most used sensors, actuators and programming logic controllers. You will be able to program small control tasks. The second part of the course will focus on the process automation in electrical power supply networks. Beside the required field and data components you will get a broad understanding into the network operation principles and tasks of the grid operators.

Calculation of student workload:
56 h SWS / presence time / working hours
68 h Exam preparation
56 h Preparation / follow-up work

Are there optional courses in the modules?
no

Language(s) of instruction:
English / German

Responsible for the module:
Prof. Dr.-Ing. Johanna Myrzik

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English / German

Description:
Anzahl Prüfungsleistungen: 1.

Module courses

Course: Process Automation in Power Grids

Frequency:
winter semester, yearly

Language(s) of instruction:
English / German

Contact hours:
4,00

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung

Associated module courses

Process Automation in Power Grids (Lecture)

Process Automation in Power Grids (Lecture)

Module 01-ET-MA-SAMS(a): Sensors and Measurement Systems
Sensors and Measurement Systems

Assignment to areas of study:
- CMM Compulsory Modules

Content-related prior knowledge or skills:
none

Learning content:
The class will cover fundamentals of sensor science starting at the underlying physical mechanisms, different sensor devices, and integrated sensor systems. Process technology used to fabricate sensors will be discussed.

The following sensors will be addressed:

• Thermal Sensors

• Force and Pressure Sensors

• Inertial Sensors

• Magnetic Sensors

• Flow Sensors

Reference:

Walter Lang: Sensors and Measurement systems, ISBN-10: 877022028X

Learning outcomes / competencies / targeted competencies:
Students will gain an overview on different sensor technologies that will enable them to select a particular sensor for a defined application. They will be able to understand the working mechanism of various sensors and to make suggestions on how to improve their performance. Furthermore, they will be able to understand and optimize the different processing steps of a complex sensor module.

Calculation of student workload:
56 h SWS / presence time / working hours
56 h Preparation / follow-up work
68 h Exam preparation

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr.-Ing. Björn Lüssem

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English

Description:
Anzahl der Prüfungsleistungen: 1

Module courses

Course: Sensors and Measurement Systems

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
4,00

Literature:
Walter Lang: Sensors and Measurement systems, ISBN-10: 877022028X

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung

Associated module courses

Sensors and Measurement Systems (Lecture)

Sensors and Measurement Systems (Lecture)

Module 01-ET-MA-PMA: Projektarbeit (Project)
Project

Assignment to areas of study:
- CMM Compulsory Modules

Content-related prior knowledge or skills:
ref. examination regulations

Learning content:
The project is an autonomous, though supervised piece of scientific work. It can be done in a group of students or as the work of one single student. If done in a group, each student's contribution and part must be clearly distinguishable. In each case a specific topic is defined by the student together with the supervisor. The project is an independent work of research. It is documented in a project thesis.

Learning outcomes / competencies / targeted competencies:
Within the project, the student learns to perform scientific investigations and to document them in the form of a thesis and a presentation of the results. The student also learns how to work in a group of scientists.

After the project, the student should be prepared for the master thesis.The project will also be presented, generally in the seminar of the institute of the supervisor as an oral presentation.

Calculation of student workload:

Are there optional courses in the modules?
no

Language(s) of instruction:
German / English

Responsible for the module:
N. N.

Frequency:
each semester

Duration:

The module is valid since / The module is valid until:
SoSe 26 / -

Credit points / Workload:
18 / 540 hours

This module is ungraded!

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English / German

Module 01-ET-BA-DHDL(a): Entwurfsverfahren mit Hardwarebeschreibungssprachen / Design Methodologies with Hardware Description Languages (3 CP) MPO 2019/BPO 2020

Design Methodologies with Hardware Description Languages

Assignment to areas of study:

- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:

none

Learning content:

Introduction

- IC technologies, design flow and abstraction levels
- Introduction to hardware description languages

Hardware modeling

- Main concept of VHDL
- Discrete event model
- Data types and operators in VHDL

Code structures and structural descriptions

- Structural elements in VHDL
- Hardware partitioning and hierarchies
- Design-for-reuse: generics and generates

RTL level modeling and synthesizable code

- Standard libraries
- Code quality recommendations
- Synthesis and synthesis constraints

Gate level modeling and back-annotation

- VITAL

Behavioral level

- Advanced concepts: files, access types and assertions
- Test benches

EDA Design Flow

Learning outcomes / competencies / targeted competencies:

The students gain in-depth knowledge of the theoretical basics of methods and tools in hardware design with hardware description languages and strategies for their practical application.

Students can describe, simulate and optimize digital modules in a hardware description language as well as synthesize them for ASICs or FPGAs.

Calculation of student workload:

30 h Exam preparation
28 h SWS / presence time / working hours
32 h Preparation / follow-up work

Are there optional courses in the modules?
no

Language(s) of instruction:
German / English

Responsible for the module:
Prof. Dr.-Ing. Alberto Garcia-Ortiz

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
3 / 90 hours

Module examinations

Module examination: Modulprüfung

Type of examination: module exam

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
German / English

Description:
Anzahl Prüfungsleistungen: 1

Module courses

Course: Design Methodologies with Hardware Description Languages

Frequency:
summer semester, yearly

Language(s) of instruction:
German / English

Contact hours:
2,00

Literature:
Literatur zum Modul wird zu Semesterbeginn in den jeweiligen Veranstaltungen bekanntgegeben.

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung

Module 01-ET-BA-STSCN(a): Selected Topics in Sustainable Communication Networks

Selected Topics in Sustainable Communication Networks

Assignment to areas of study:

- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:

none

Learning content:

This module offers the opportunity to learn and discuss various aspects and research fields of sustainability for communication networks, such as:

- Wireless (underground) sensor networks
- Environmental monitoring
- Smart agriculture
- Opportunistic networks
- Energy efficiency in communication networks
- Societal aspects of modern communications

A list of references will be provided at the start of the semester.

Learning outcomes / competencies / targeted competencies:

The students will learn about various research fields and applications of communication networks, which target the sustainable development goals (SDG) of the United Nations. The students will individually explore a given topic (with the help of research publications or other scientific materials) and prepare a presentation which will be discussed in class with the lecturer and the peers.

Calculation of student workload:

62 h Preparation / follow-up work
28 h SWS / presence time / working hours

Are there optional courses in the modules?

no

Additional comments:

A list of references will be provided at the start of the semester.

Language(s) of instruction:

English

Responsible for the module:

Prof. Dr. Anna Förster

Frequency:

each semester

Duration:

1 semester[s]

The module is valid since / The module is valid until:

SoSe 24 / -

Credit points / Workload:

3 / 90 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English

Description:
Anzahl Prüfungsleistung: 1 (written report and presentation thereof)

Module courses

Course: Selected Topics in Sustainable Communication Networks*** LV neu ***

Frequency:
each semester

Language(s) of instruction:
English

Contact hours:
2,00

Literature:
A list of references will be provided at the start of the semester.

Teaching format(s):
Seminar

Associated module examination:
Modulprüfung

Module 01-ET-MA-ACC: Advanced Channel Coding
Advanced Channel Coding

Assignment to areas of study:
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
none

Learning content:
- Turbo Codes
- LDPC Codes
- Polar Codes
- Algebraic Coding
- Coded Modulation
- Adaptive Error Control

Learning outcomes / competencies / targeted competencies:
After this course, the students should be able to:

- understand advanced coding techniques and perform the decoding;
- explain the principle of coded modulation and possible realizations;
- understand the principle of adaptive error control schemes and the difference to forward error correction;
- implement principle encoder and decoder functions in software.

Calculation of student workload:
56 h SWS / presence time / working hours
56 h Preparation / follow-up work
68 h Exam preparation

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Dr.-Ing. Dirk Wübben

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Oral

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English / German

Description:
Prüfungstyp: Modulprüfung

Anzahl Prüfungsleistung: 1

Module courses

Course: Advanced Channel Coding

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
4,00

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung

Module 01-ET-MA-ADC: Advanced Digital Communications
Advanced Digital Communications

Assignment to areas of study:
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
Wireless Communication, Channel Coding

Learning content:
- Information Theory for fading channels and MIMO systems
- Multiple antenna systems
- Factor graphs
- Selected topics

Literatur zum Modul wird in den jeweiligen Veranstaltungen bekanntgegeben.

Learning outcomes / competencies / targeted competencies:
After this course, the students will be able to

- understand basic concepts and information theory limits for MIMO systems;
- understand diversity as well as rate enhancement in MIMO systems;
- understand various detection principles and algorithms for MIMO systems.

Calculation of student workload:
34 h Exam preparation
28 h Preparation / follow-up work
28 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Dr.-Ing. Carsten Bockelmann

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
3 / 90 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Oral

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English / German

Description:
Prüfungstyp: Modulprüfung.

Anzahl Prüfungsleistungen: 1.

Prüfungsform: Mündlich (Prüfungsleistung).

Module courses

Course: Advanced Digital Communications

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
2,00

Literature:
Literatur zum Modul wird in den jeweiligen Veranstaltungen bekanntgegeben.

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung

Module 01-ET-MA-Akku: Akkumulatoren - Von den Grundlagen bis zur Anwendung
Accumulators - Batteries: From the Basic to Application

Assignment to areas of study:
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
none

Learning content:
The contents of the course are supported by practical experiments at Fraunhofer IFAM.

- Areas of application of accumulators
- Fundamentals, materials and concepts for batteries (functional principle, kinetic and thermodynamic principles, explanation of thermodynamic state functions, theoretical cell voltage, battery cell types and designs)
- Chemical and physical analysis methods and common electrochemical characterization, capacity & resistance determination of galvanic cells, battery testing technology (impedance spectroscopy)
- Battery state of health determination, methods for determining the ageing condition
- Battery system technology (operating strategies, charging methods, battery monitoring, reliability, ageing and battery safety)
- Manufacturing technology of the battery cell production chain & battery recycling
- Application scenarios and for stationary and mobile battery systems (costs, sustainability, next generation battery technologies)

Learning outcomes / competencies / targeted competencies:
The students learn the thermodynamic and kinetic fundamentals of energy storage. They are familiarized with the important fundamentals and aspects of electrical energy storage with a focus on rechargeable battery systems and how these are used in different applications. They will learn how to use suitable methods to characterize the ageing of batteries and thus optimize their operation for different applications. Furthermore, the students gain knowledge of battery system technology and battery monitoring. Finally, they will gain an insight into future developments with regard to costs, sustainability and storage performance.

Calculation of student workload:
28 h Preparation / follow-up work
34 h Exam preparation
28 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr.-Ing. Johanna Myrzik

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 25 / -

Credit points / Workload:
3 / 90 hours

Module examinations

Module examination: Modulprüfung

Type of examination: module exam

Form of examination:
Oral

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
German / English

Module courses

Course: Accumulators - Batteries: From the Basic to Application

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
2,00

Teaching format(s):
Lecture

Associated module examination:

Module 01-ET-MA-Ant(a): Antennas and Propagation
Antennas and Propagation

Assignment to areas of study:
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
"Theory of electrical engineering - TET"
and "Grundlagen der Kommunikations- und Informationstechnik" are strongly recommended.

Learning content:
- Fields and wave in free space based on Maxwell's equations
- Fundamentals of wave propagation
- Fundamentals of antennas
- Hertz Dipole amd magnetic dipole
- Antenna arrays
- Antenna beamforming and beamsteering
- Calculation of aperture antennas
- Microstrip patch antennas
- Presentation and discussion of practical examples

Learning outcomes / competencies / targeted competencies:
After this course, the students know how

- to describe the fundamentals of wave propagation
- to explain the working principle of antennas;
- to decide which type of antennas suits a certain application at a certain frequency;
- to apply the method of electrodynamic potentials for solving antenna problems;
- to explain and to apply the method.

Calculation of student workload:
56 h SWS / presence time / working hours
68 h Exam preparation
56 h Preparation / follow-up work

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr.-Ing. Martin Schneider

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English / German

Description:
Anzahl Prüfungsleistungen: 1

Module courses

Course: Antennas and Propagation

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
4,00

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung

Module 01-ET-MA-AtD(a): Analog to digital Converters
Analog to digital Converters

Assignment to areas of study:
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
none

Learning content:
- Theory of analog digital conversion
- Static and dynamic errors
- Sample and hold circuits
- Realisations of ADCs, parallel structures, multistage converters, SAR ADCs, delta sigma ADCs

Learning outcomes / competencies / targeted competencies:
After this course, the students
- know the basic modules of ADCs;
- understand errors in ADCs;
- know how to select the appropriate structure for a given specification.

Calculation of student workload:
56 h Preparation / follow-up work
68 h Exam preparation
56 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr.-Ing. Steffen Paul

Frequency:

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Oral

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English / German

Description:
Prüfungstyp: Modulprüfung

Prüfungsform: Mündlich (Prüfungsleistung)

Module courses

Course: Analog to Digital Converters

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
4,00

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung

Module 01-ET-MA-CIMP(a): Computational Intelligence in Modelling, Prediction and Signal Processing

Computational Intelligence in Modelling, Prediction and Signal Processing

Assignment to areas of study:

- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:

none

Learning content:

- Introduction to CI & their applications
- Principal constituents of CI
- Fuzzy sets and properties, Fuzzy relation
- Fuzzy logic systems (Mamdani, TS, singleton, relational model)
- Fuzzy inferencing mechanism
- Generation of fuzzy rule (Wang's method)
- Clustering and LSE based rule generation
- Neuro implementation of fuzzy system
- Introduction to ANFIS / neuro-fuzzy network
- Backpropagation, Marquardt training algorithm for neuro-fuzzy network
- Problems in automatic data driven rule generation
- CI Applications in modelling, prediction and intelligent signal processing

Learning outcomes / competencies / targeted competencies:

After this course, students should be able to:

- understand the importance of computationally intelligent techniques based on fuzzy logic, neural networks, genetic algorithms and fuzzy-neural networks in engineering applications;
- understand the difference between the classical set and fuzzy set, fuzzy set as generalization of crisp set and terms like fuzzy arithmetic, fuzzy logic systems, fuzzification, fuzzy relation, fuzzy-rules, defuzzification, and inferencing mechanism, tuning membership functions etc;
- generate fuzzy rules through learning from examples and clustering method Implement and fine tune the fuzzy logic system using neural networks based technology;
- analyze the transparency, interpretability and accuracy of the fuzzy/ fuzzy-neural model;
- apply fuzzy logic / fuzzy-neural systems in (white box) system modeling, data prediction and linearization of nonlinear sensor characteristic, adaptive filtering purposes etc.

Calculation of student workload:

28 h Preparation / follow-up work
28 h SWS / presence time / working hours
34 h Exam preparation

Are there optional courses in the modules?

no

Language(s) of instruction:

English

Responsible for the module:

PD Dr.-Ing. Ajoy Palit

Frequency:

winter semester, yearly

Duration:

1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
3 / 90 hours

Module examinations

Module examination: Kombinationsprüfung

Type of examination:

Form of examination:
Portfolio (AT § 8 Abs. 8)

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
German

Description:
Prüfungstyp: Kombinationsprüfung (Written examination and programming exercise)

Module courses

Course: Computational Intelligence in Modelling, Prediction and Signal Processing

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
2,00

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Kombinationsprüfung

Module 01-ET-MA-CTh3(a): Control Theory 3 / Regelungstheorie 3
Control Theory 3

Assignment to areas of study:
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
Control Theory 1, Control Theory 2 und Nonlinear Systems

Learning content:
Die Veranstaltung umfasst weiterführende Konzepte aus dem Bereich der Regelungstheorie, welche zum Teil als fester Bestandteil des Moduls vom Dozent, zum Teil von den Studierenden in Referatform aufbereitet und präsentiert werden. Folgende Inhalte werden obligatorisch behandelt:

· Mathematische Grundlagen zu den Lerninhalten

· Ein-/Ausgangssteuerbarkeit

· Exakte Linearisierung

· µ-Synthese

· Regelungs-Ljapunov-Funktionen

Darüber hinaus werden im Rahmen der Referate der Studierenden weiterführende Themen vorgestellt wie z. B. Modellprädiktive Regelung, Flachheits- und Passivitätsbasierte Regelung, Nichtlineare Zustandsbeobachter, Modellordnungsreduktion, etc..

Literaturhinweise zum Modul werden in den jeweiligen Veranstaltungen bekanntgegeben.

Learning outcomes / competencies / targeted competencies:
Nach erfolgreichem Abschluss des Moduls können die Studierenden

· grundlegende Konzepte und Definitionen der Regelungstheorie auf allgemeine, nichtlineare Systeme übertragen,

· die Prinzipien spezieller regelungstheoretische Ansätze wie die µ-Synthese oder die exakte Linearisierung erläutern und diese Verfahren auf allgemeine Systeme anwenden sowie

Themen aus dem Bereich der Regelungstheorie eigenständig recherchieren, aufbereiten und im Rahmen einer Präsentation strukturiert darstellen und die Methode kritisch hinterfragen

Calculation of student workload:
28 h SWS / presence time / working hours
48 h Exam preparation
14 h Preparation / follow-up work

Are there optional courses in the modules?
no

Language(s) of instruction:
German / English

Responsible for the module:
Prof. Dr.-Ing. Kai Michels

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
3 / 90 hours

Module examinations

Module examination: Modulprüfung

Type of examination: module exam

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
German

Module courses

Course: Control Theory 3, Regelungstheorie 3

Frequency:
winter semester, yearly

Language(s) of instruction:
German / English

Contact hours:
2,00

Teaching format(s):
Lecture

Associated module examination:
Modulprüfung

Module 01-ET-MA-ComT(a): Communication Technologies
Communication Technologies

Assignment to areas of study:
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
System theory, stochastic systems, basics of communication theory

Learning content:
- Nonlinear digital modulations
- Coherent receivers using carrier recovery and incoherent receivers used for differential modulations
- Decision theory (minimization of probability of error and expected cost)
- Maximum a posteriori (MAP) detection / maximum likelihood (ML) detection
- Linear equalization (MMSE/LS-equalizer, Decision-Feedback equalizer)

Learning outcomes / competencies / targeted competencies:
After the course, the students will be able to

- understand the fundamentals of nonlinear digital modulation like MSK, GMSK;
- understand the pros-and cons of coherent with decision feedback carrier recovery and incoherent reception for linear and non-linear modulations;
- understand the theory of data decision, to explain the MAP/ML-detection principle and to design related MAP/ML-receivers (e.g. Forney/Viterbi (MLSE) equalizer);
- to understand the method of linear equalization and to design MMSE/LS- and decision feedback equalizer.

Calculation of student workload:
56 h SWS / presence time / working hours
68 h Exam preparation
56 h Preparation / follow-up work

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof.Dr.-Ing. Armin Dekorsy

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English / German

Description:
Anzahl Prüfungsleistungen: 1

Module courses

Course: Communication Technologies

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
4,00

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung

Module 01-ET-MA-DDLA: Architectures and Design-Methods for Deep-Learning Acceleration

Architectures and Design-Methods for Deep-Learning Acceleration

Assignment to areas of study:

- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:

Lectures "Architectures and Design Methodologies of Integrated Digital Systems" and "Advanced Digital System Design" are highly recommended.

Learning content:

- Fundamentals of deep-learning and its applications
- Dedicated hardware architectures for deep-learning
- Implementation and training of neural networks using a SOTA Python frameworks (e.g., Tensorflow)
- Hardware architectures and design methodologies for improved deep-learning inference on constrained devices (e.g., IoT nodes and embedded systems)
- Domain-specific deep-learning architectures

A list of references will be provided at the start of the semester.

Learning outcomes / competencies / targeted competencies:

The students acquire specialized knowledge about the hardware architectures that empower IoT and other embedded devices to perform computationally complex deep-learnign tasks, originally only suitable for large server devices. Thereby, the students will not only learn the structure of modern deep-learning networks for computer vision and natural language processing, but also how to build and train their own networks, based on the constraints of the target system (e.g., a low memory footprint). Moreover, the students will learn how modern domain-specific architectures - aimed at accelerating deep-learning applications - are conceived and implemented.

Calculation of student workload:

56 h SWS / presence time / working hours
68 h Exam preparation
56 h Preparation / follow-up work

Are there optional courses in the modules?

no

Language(s) of instruction:

English

Responsible for the module:

Prof. Dr.-Ing. Alberto Garcia-Ortiz

Frequency:

winter semester, yearly

Duration:

1 semester[s]

The module is valid since / The module is valid until:

WiSe 24/25 / -

Credit points / Workload:

6 / 180 hours

Module examinations

Module examination: Modulprüfung

Type of examination: module exam

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Module courses

Course: Architectures and Design-Methods for Deep-Learning Acceleration

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
4,00

Teaching format(s):
Lecture

Associated module examination:
Modulprüfung

Module 01-ET-MA-DIDS(a): Architectures and Design Methodologies of Integrated Digital Systems

Architectures and Design Methodologies of Integrated Digital Systems

Assignment to areas of study:

- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:

none

Learning content:

- Design tools and abstractions levels
- Physical design: floorplanning and placement; routing and wire estimation; DRC and LVS
- Design-for-Test: scan-based design, boundary scan; BIST
- Test architectures for SoCs
- Test generation and error diagnosis: ATPG; fault simulation

Learning outcomes / competencies / targeted competencies:

The students will learn the design methodologies, theoretical algorithms, and tools used for the development of microelectronic integrated systems, as well as the strategies regarding their practical implementation with industrial CAD tools. The students will be able to implement a complex microelectronic integrated digital system guaranteeing its correctness and testability.

Calculation of student workload:

56 h SWS / presence time / working hours
68 h Exam preparation
56 h Preparation / follow-up work

Are there optional courses in the modules?

no

Language(s) of instruction:

English

Responsible for the module:

Prof. Dr.-Ing. Alberto Garcia-Ortiz

Frequency:

summer semester, yearly

Duration:

1 semester[s]

The module is valid since / The module is valid until:

SoSe 24 / -

Credit points / Workload:

6 / 180 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English / German

Description:
Anzahl der Prüfungsleistungen: 1

Module courses

Course: Architectures and Design Methodologies of Integrated Digital Systems

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
4,00

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung

Module 01-ET-MA-DMSS(a): Design of Mixed-Signal Systems
Design of Mixed-Signal Systems

Assignment to areas of study:
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
none

Learning content:
Mixed-systems design overview based on the example of 8 bit SAR ADC in 45 nm CMOS

Learning outcomes / competencies / targeted competencies:
- System-level simulation of mixed signal systems
- In-depth understanding of process and mismatch on the system parameters

Calculation of student workload:
56 h Preparation / follow-up work
68 h Exam preparation
56 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr.-Ing. Steffen Paul

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Oral

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English / German

Description:
Prüfungstyp: Modulprüfung

Anzahl Prüfungsleistung: 1

Module courses

Course: Design of Mixed-Signal Systems

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
4,00

Teaching format(s):

Associated module examination:
Modulprüfung

Module 01-ET-MA-DS(a): Diskrete Systeme
Discrete Systems

Assignment to areas of study:
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
Vorlesung “Control Theory I”

Learning content:
- Sampling theorem
- Linear difference equations
- State space description of discrete linear systems
- Stability of discrete systems
- Transformation of a continuous model into a discrete model
- z-transformation
- Controller design for discrete systems
- Adaptive control
- Fuzzy control
- Neural networks

References:

German and English:

- K. Michels: Control Engineering (Script)

English:

- K. Michels: Fuzzy Control
- Norman S. Nise: Control Systems Engineering
- Karl J. Astrom: Adaptive Control
- Ioan Dore Landau: Adaptive Control

Learning outcomes / competencies / targeted competencies:
Einsicht in bisher nicht behandelte Themen der Regelungstechnik: Diskrete Systeme, Adaptive Regelungen, Fuzzy-Regler und Neuronale Netze.

Insight into control engineering topics not previously covered: discrete systems, adaptive control, Fuzzy controller and Neural Networks.

Calculation of student workload:
68 h Exam preparation
56 h SWS / presence time / working hours
56 h Preparation / follow-up work

Are there optional courses in the modules?
no

Language(s) of instruction:
English / German

Responsible for the module:
Prof. Dr.-Ing. Kai Michels

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English / German ((Skript liegt auf Deutsch und Englisch vor))

Description:
Anzahl der Prüfungsleistungen: 1

Module courses

Course: Diskrete Systeme/Discrete Systems

Frequency:
summer semester, yearly

Language(s) of instruction:
English / German (Ein detailliertes Vorlesungsskript liegt auf Deutsch und Englisch vor / A detailed script in German and English is available)

Contact hours:
4,00

Literature:
Vorlesungsmanuskript (Englisch und Deutsch) in Buchform liegt vor.

- K. Michels: Control Engineering (Script)
- Michels: Fuzzy Control
- Norman S. Nise: Control Systems Engineering
- Karl J. Astrom: Adaptive Control
- Ioan Dore Landau: Adaptive Control

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung

Module 01-ET-MA-DezE(a): Dezentrale Energieversorgung
Distributed Energy System

Assignment to areas of study:
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
none

Learning content:
- Wandel der Energieversorgung von zentral zu dezentral
- Anlagentechnologien der dezentralen und regenerativen Energieversorgung
- Risiken und Vorteile dezentraler Energieversorgung
- Wirtschaftliche und technische Randbedingungen
- Planung und Betrieb dezentraler Netze

Literatur zum Modul wird in den jeweiligen Veranstaltungen bekanntgegeben.

Learning outcomes / competencies / targeted competencies:
Nach erfolgreichem Abschluss des Moduls kennen die Studierenden den Wandel der Energieversorgung, der sich von einer gewachsenen zentralen Struktur hin zu dezentralen Einheiten vollzieht. Darüber hinaus sind sie mit den unterschiedlichen Anlagentechnologien zur dezentralen und regenerativen Energieversorgung vertraut. Die Studierenden können die Risiken und Vorteile von dezentralen Energiesystemen einschätzen. Sie können die wirtschaftlichen und technischen Randbedingungen für die dezentrale Energieeinspeisung sicher einhalten und Netze für eine dezentrale Versorgung planen und betreiben.

Calculation of student workload:
80 h Exam preparation
38 h Preparation / follow-up work
42 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
German / English

Responsible for the module:
Prof. Dr.-Ing. Johanna Myrzik

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Kombinationsprüfung

Type of examination:

Form of examination:
Presentation and written assignment

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
German / English

Description:
ACHTUNG! Gemäß MPO-WiIng-ET-IT-02-22 und AeO_MSc-WiIng-ET-IT-02-22:

Bezeichnung/Prürungstyp: Modulprüfung

Anzahl der Prüfungsleistungen: 1

Module courses

Course: Dezentrale Energieversorgung

Frequency:
winter semester, yearly

Language(s) of instruction:
German / English

Contact hours:
3,00

Teaching format(s):
Lecture
Seminar

Associated module examination:
Kombinationsprüfung

Module 01-ET-MA-DiTe(a): Digital Technology
Digital Technology

Assignment to areas of study:
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
none

Learning content:
- Timing strategies
- Non-programmable hardware modules
- Programmable hardware modules
- Selected algregraic and Boolean operations
- Introduction to digital coding

Learning outcomes / competencies / targeted competencies:
Die Studierenden
- erlernen spezielle Fähigkeiten zur Realisierung funktionsspezifischer digitaler, kombinatorischer und komplexer sequentieller Schaltungen;
- erwerben Grundwissen zur Realisierung digitaler Module;
- erlernen verschiedene Strategien für die Realisierung digitaler Module (z.B. Datenpfad+Steuerpfad, Synchron vs. Asynchron, Programmierbarkeit, …);
- beherrschen Entwurfs- und Analysemethoden von Schaltnetzen und Schaltwerken;
- erlernen spezielle Fähigkeiten zur Realisierung funktionsspezifischer digitaler Systeme.

Calculation of student workload:
68 h Exam preparation
56 h SWS / presence time / working hours
56 h Self-study

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr.-Ing. Alberto Garcia-Ortiz

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English / German

Description:
Anzahl Prüfungsleistungen: 1

Module courses

Course: Digital Technology

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
4,00

Teaching format(s):

Associated module examination:
Modulprüfung

Module 01-ET-MA-ENC: Emerging Networking Concepts
Emerging Networking Concepts

Assignment to areas of study:
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
Grundkenntnisse Kommunikationsprotokolle

Learning content:
This course examines emerging research topics and advanced concepts in computer networking through a dynamic curriculum updated each semester. Specific topics are announced at course commencement; past offerings have covered Internet of Things, sensor networks, space communications, information-centric networking, vehicular networks, and software-defined networking. For each topic, students receive theoretical instruction and complete practical assignments to apply and reinforce knowledge. A comprehensive final examination assesses overall understanding of emerging networking paradigms and their technical foundations.

Learning outcomes / competencies / targeted competencies:
Upon completion, students will demonstrate a comprehensive understanding of emerging networking technologies through theoretical knowledge and practical application. Graduates will be able to analyze cutting-edge networking paradigms, apply concepts through problem-solving assignments, evaluate technical trade-offs, and synthesize knowledge across multiple research domains. These competencies enable students to engage with evolving networking technologies in research-oriented thesis work and professional roles in network architecture, protocol development, and technology evaluation.

Calculation of student workload:
42 h SWS / presence time / working hours
82 h Exam preparation
56 h Preparation / follow-up work

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Dr.-Ing. Asanga UDUGAMA

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
4 / 120 hours

Module examinations

Module examination: Modulprüfung

Type of examination: combination exam

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
3 / - / -

Language(s) of instruction:
German / English

Description:
Bitte beachten - Bezeichnung: Kombinationsprüfung. Gemäß MPO-CIT-02-22 und AeO_MSc-CIT02-22, Anzahl der Prüfungsleistungen: 2.

Successful assessment of homework assignments
and a successful project preparation and
presentation thereof.

Module courses

Course: Emerging Networking Concepts

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
3,00

Literature:
A list of references will be provided at the start of the semester.

Additional comments:
Dozent: Dr. Asanga Udugama

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung

Module 01-ET-MA-EdComL-P: Edge Computing Lab
Edge Computing Lab

Assignment to areas of study:
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
Intermediate programming skills (Python, C, C++)

Learning content:
This module focuses on Internet of Things, their design and implementation. Topiccs include:

- Introduction to the Internet of Things
- Networking basics for Internet of Things
- Architectures and programming languages for Internet of Things
- Energy issues in the Internet of Things
- Machine Learning for the Internet of Things
- Use cases and applications

Learning outcomes / competencies / targeted competencies:
The students will be able to design and implement on their own and with real hardware small-size projects, consisting of several networked IoT devices. They wil be able to select the proper devices, to analyse use cases for their energy and communication requirements, and to implement these use cases. Additionally, they will be able to design, train and test machine learning models especially for resource-limited IoT devices.

Calculation of student workload:
50 h Self-study
42 h Preparation / follow-up work
28 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr. Anna Förster

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 25 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Prüfung Edge Computing Lab

Type of examination: module exam

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Module courses

Course: Edge Computing Lab

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
4,00

Teaching format(s):
Laboratory class

Associated module examination:
Prüfung Edge Computing Lab

Module 01-ET-MA-InfTh: Information Theory
Information Theory

Assignment to areas of study:
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
Basics of Communication Technologies or equivalent, Stochastic Systems or equivalent

Learning content:
- Fundamental information theoretic measures
- Source coding theorem
- Noisy-Channel coding theorem
- Gaussian channels

Learning outcomes / competencies / targeted competencies:
After the course, the students

- are familiar with the fundamentals of Shannon theory including its limitations and important coding theorems;
- can apply these results to measure the quality of functional blocks in a communication system (data compression, channel coding) and the quality of the communication channel (capacity);
- are aware of the proofs of the limits of lossless compression of data sources (source coding theorem) and asymptotic error free communication (channel coding theorem);
- know fundamental information theoretic measures and their most important porperties; they are able to explain their operational meaning and are proficient in applying them;
- are able to read and understand scientific documents on information theory

Calculation of student workload:
28 h SWS / presence time / working hours
28 h Preparation / follow-up work
34 h Exam preparation

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Dr.-Ing. Bho Matthiesen

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
3 / 90 hours

Module examinations

Module examination: Modulprüfung

Type of examination: module exam

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Module courses

Course: Prüfung zu Information Theory

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
4,00

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung

Module 01-ET-MA-LPWSN(a): Low Power Strategies in Wireless Sensor Networks
Low Power Strategies in Wireless Sensor Networks

Assignment to areas of study:
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
none

Learning content:
Introduction of wireless sensor networks from node to network; overview of techniques for nodes' power management including communication protocols, data processing algorithms; introduction of WSN motes' operation.

A list of references will be provided at the start of the semester.

Learning outcomes / competencies / targeted competencies:
- To understand the principle of wireless sensor networks
- To understand related techniques for power management
- To get familiar with the mote operation and current research in WSNs

Calculation of student workload:
34 h Exam preparation
28 h SWS / presence time / working hours
28 h Preparation / follow-up work

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr.-Ing. Alberto Garcia-Ortiz

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
3 / 90 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Oral

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English

Description:
Prüfungstyp: Modulprüfung

Module courses

Course: Low Power Strategies in Wireless Sensor Networks

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
2,00

Literature:
A list of references will be provided at the start of the semester.

Teaching format(s):

Associated module examination:
Modulprüfung

Module 01-ET-MA-MSAE(a): Modeling and Simulation of Sensors, Circuits and Systems in Automotive Electronics

Modeling and Simulation of Sensors, Circuits and Systems in Automotive Electronics

Assignment to areas of study:

- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:

Electrical circuit theory, Mathematics and C++ / MATLAB programming

Learning content:

- FEM applications in automotive electronics
- Inductive, capacitive, resistive and magnet based automotive sensors modeling
- Stationary, time dependent and frequency domain modeling of automotive sensors
- Monte-Carlo & Worst-Case simulations
- Modeling & simulation of NFC-antenna
- NFC-antenna measurements using VNA & matching circuit design using RF-simulation
- Thermal simulation of automotive electronics using FEM
- Theoretical estimation of sensor signal using transfer function blocks (Laplace transform)
- LTSPICE simulation of sensor circuit
- Reliability calculation

Learning outcomes / competencies / targeted competencies:

After this course, students should be able to:

- understand the Finite Elements Methods (FEM) and its application to inductive, capacitive, resistive sensors and magnet based Hall automotive sensors modeling etc.;
- understand the stationary, frequency domain and time dependent studies and parametric simulation of aforementioned sensors using COMSOL-Multiphysics/CST-Tool;
- estimate the sensor's signal conditioner output (mV or mA) using transfer function blocks;
- verify the sensors' signal output using circuit simulation (LTSPICE) software;
- undertake processing of sensor's signal (MATLAB/C++ programming) in order to estimate linear & angular positions etc. and linearity test of sensor;
- estimate the tolerance band of sensor's signal conditioner circuit using Monte-Carlo simulation and worst case simulation method for the entire operating temperature range;
- perform magnetic field simulation of a current carrying conductor for the measurement of current using Hall sensor;
- model, design and extract the NFC-antenna parameter for matching circuit design;
- measure the NFC-antenna (S11) parameter with VNA (Smith Chart) and design the suitable matching circuit (for Texas Instruments, NXP & Melexis Transceiver) using RF-simulation;
- simulate & analyze the heat dissipation technique for automotive power electronic system;
- calculate the reliability (FIT/MTTF/MTBF) of automotive electronic circuits and systems.

Calculation of student workload:

56 h SWS / presence time / working hours
56 h Preparation / follow-up work
68 h Exam preparation

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
PD Dr.-Ing. Ajoy Palit

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Kombinationsprüfung

Type of examination:

Form of examination:
See description

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English

Description:
Prüfungstyp: Kombinationsprüfung

Prüfungsform: Kombinationsprüfung (written examination, simulaton exercise)

Module courses

Course: Modeling and Simulation of Sensors, Circuits and Systems in Automotive Electronics

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
4,00

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Kombinationsprüfung

Module 01-ET-MA-NGCN(a): Next Generation Cellular Networks
Next Generation Cellular Networks

Assignment to areas of study:
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
Content of courses: Wireless Communications, Communication Technologies and basics in digital signal processing

Learning content:
- Mobile communications: History and basics
- LTE/LTE-Advanced (4G) mobile communications
- 5G mobile communication system
- 6G mobile communication system

Learning outcomes / competencies / targeted competencies:
After the course, the students will:

- be able to understand the 4G and 5G system architecture, its key components and interfaces;
- be able to understand the basic design approaches of 4G and 5G mobile communication systems including RRM methods, MAC protocols, PHY layer baseband technologies;
- be able to understand the 4G and 5G system components such as basestations, mobile handsets and gateways and related interconnections;
- gain first insights into 6G and its key technologies
- be able to model and evaluate mobile communication system performances;
- have gained insight into the 3GPP standardization and its processes.

Calculation of student workload:
28 h SWS / presence time / working hours
34 h Exam preparation
28 h Preparation / follow-up work

Are there optional courses in the modules?
no

Language(s) of instruction:
English / German

Responsible for the module:
Prof.Dr.-Ing. Armin Dekorsy

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
3 / 90 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Oral

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English / German

Description:
Anzahl Prüfungsleitung: 1

Module courses

Course: Next Generation Cellular Networks

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
2,00

Teaching format(s):

Associated module examination:
Modulprüfung

Module 01-ET-MA-NLS(a): Nonlinear Systems
Nonlinear Systems

Assignment to areas of study:
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
Vorlesung “Grundlagen der Regelungstechnik” / basics of control (bode diagrams, nyquist plots, nyquist stability criterion, PID controller design)

Learning content:
- Grundlagen und Eigenschaften nichtlinearer Systeme / Basics and features of nonlinear systems
- Schaltende Übertragungsglieder / Switching transfer elements
- Stabilitätsdefinition für nichtlineare Systeme / Definition of stability for nonlinear systems
- Direkte Methode von Lyapunov / Direct method of Lyapunov
- Beschreibungsfunktion / Describing function
- Kreiskriterium / Circle Criterion
- Hyperstabilität / Hyperstability
- Sliding-mode control
- Gain Scheduling

- Basics and features of nonlinear systems
- Switching functions as transfer elements
- Definition of stability for nonlinear systems
- Direct method of Lyapunov
- Describing function
- Circle criterion
- Hyperstability
- Sliding-mode control
- Gain Scheduling

Learning outcomes / competencies / targeted competencies:
Aufbauend auf der Vorlesung „Grundlagen der Regelungstechnik“, in der ausschließlich lineare Systeme behandelt wurden, werden in dieser Vorlesung nichtlineare Systeme mit ihren spezielle Eigenschaften sowie den entsprechenden Lösungsansätzen zur Regelung dieser Systeme behandelt. Die Studierenden erwerben das nötige Handwerkszeug, um für einfache nichtlineare Systeme in der Praxis eine Regelung auslegen zu können.

Based on the lecture „Grundlagen der Regelungstechnik“ (Basics of Control Engineering), where only linear systems were discussed, this lecture will concentrate on nonlinear systems with their special features and suitable control solutions. The students shall learn to handle nonlinearities in simple control loops.

Calculation of student workload:
56 h SWS / presence time / working hours
68 h Exam preparation
56 h Preparation / follow-up work

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr.-Ing. Kai Michels

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English

Description:
Anzahl Prüfungsleistung: 1

Schriftlich oder mündlich, abhängig von der Anzahl der Teilnehmer.

Written or oral, depending on number of participants.

Module courses

Course: Nonlinear Systems

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
4,00

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung

Module 01-ET-MA-NbPQ(a): Methoden der Netzberechnung und Power Quality
Calculation Methods for Electrical Power Systems and Power Quality

Assignment to areas of study:
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
none

Learning content:
- Generation and load profiles
- Power transmission, voltage maintenance, and grid losses
- Modern methods of load flow calculation
- Calculation of asymmetrically fed three-phase grids
- Calculation of asymmetrical short circuits
- Power quality: definitions and standards
- Harmonic load in grids
- Voltage dips and flicker
- Principles for the planning of power systems
- Mathematical models (generation, load, market and network) for planning of power systems
- Optimization problem for the planning of power systems
- Power flows and optimization in Python for planning of power systems

Learning outcomes / competencies / targeted competencies:
Upon successful completion, students will have knowledge of the various methods for calculating transmission and distribution networks in normal and disturbed operation. They will learn the methods of symmetrical components as well as probabilistic and optimized load flow calculation. The topic of power quality provides insight into the increasing problems of network operation and reactions in the future.
From the power systems planning topic, students will be able to apply fundamental planning principles, identify suitable mathematical models for the generation, load, networks and electric-market in the planning problem, define planning optimization problems and model them mathematically, and use Python-based tools to formulate and solve planning problems in modern power systems. Students will then be able to independently carry out and evaluate network planning and comprehensive network analyses.

Calculation of student workload:
56 h Preparation / follow-up work
56 h SWS / presence time / working hours
68 h Exam preparation

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr.-Ing. Johanna Myrzik

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 26 / -

Credit points / Workload:
3 / 90 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Oral

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
German / English

Description:
Anzahl Prüfungsleistung 1 (mündlich)

Module courses

Course: Methoden der Netzberechnung und Power Quality

Frequency:
summer semester, yearly

Language(s) of instruction:
German / English

Contact hours:
2,00

Teaching format(s):
Lecture

Associated module examination:
Modulprüfung

Module 01-ET-MA-NetDy(a): Dynamik und Stabilität in Übertragungsnetzen
Dynamics and stability in transmission grids

Assignment to areas of study:
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
none

Learning content:
- Modellbildung für Stabilitätsuntersuchungen
- Statische Stabilität
- Transiente Stabilität
- Dynamische Simulation
- Frequenz-Leistungsregelung
- Spannungsstabilität und -Regelung
- Flexible AC-Transmission Systems

Learning outcomes / competencies / targeted competencies:
Nach erfolgreichem Abschluss haben die Studierenden Kenntnisse über die Modellierung von elektrischen Energieübertragungssystemen für Stabilitätsbetrachtungen. Das dynamische Verhalten und die Stabilität können anhand der Modellierungen eigenständig berechnet und analysiert werden. In den Übungen sollen erste Kenntnisse über das dynamische Simulieren von Netzen vermittelt werden.

Calculation of student workload:
56 h Preparation / follow-up work
68 h Exam preparation
56 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr.-Ing. Johanna Myrzik

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 26 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulpüfung

Type of examination:

Form of examination:
Oral

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
German

Description:
Anzahl Prüfungsleistungen: 1

Module courses

Course: Dezentrale Energieversorgung

Frequency:
winter semester, yearly

Language(s) of instruction:
German

Contact hours:
4,00

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulpüfung

Module 01-ET-MA-NetSimP: Network Simulation Project
Network Simulation Project

Assignment to areas of study:
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
Network Simulation Theory is strongly recommended, can be taken simultaneously

Learning content:
This project-based course provides hands-on experience in applying simulation techniques to the development of computer network protocols and algorithms. Students complete a semester-long research project, either selected from instructor-provided topics or self-proposed, involving design, implementation, performance evaluation, and documentation of network simulations. Successful completion of the Network Simulation Theory course is a mandatory prerequisite, ensuring students possess the necessary theoretical foundations and technical proficiency with simulation tools and methodologies.

Learning outcomes / competencies / targeted competencies:
Upon completion of this course, students will demonstrate competency in conducting independent simulation-based network research: formulating research objectives, implementing protocol simulations, executing statistically rigorous experiments, interpreting results, and documenting findings professionally. These competencies enable students to undertake research-oriented master's theses and pursue professional roles in network research and development.

Calculation of student workload:
66 h Preparation / follow-up work
10 h Self-study
14 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Dr.-Ing. Asanga UDUGAMA

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
3 / 90 hours

Module examinations

Module examination: Kombinationsprüfung

Type of examination:

Form of examination:
See description

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English

Description:
WICHTIG! Bitte beachten: Gemäß MPO-CIT-02-22 und AeO_MSc-CIT02-22, Prüfungstyp: Kombinationsprüfung. Anzahl Prüfungsleistungen: 2.

Module courses

Course: Network Simulation Project

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
1,00

Teaching format(s):
Project

Associated module examination:
Kombinationsprüfung

Module 01-ET-MA-PAT(a): Patente, Schutzrechte und geistiges Eigentum / Patents, Protective Rights and Intellectual Property

Patents, Protective Rights and Intellectual Property

Assignment to areas of study:

- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:

keine

Learning content:

Die Vorlesung ist ein eigenständiger, einsemestriger Kurs, der den Studierenden mit zahlreichen Beispielen aus der Praxis Grundlagen über das Patentrecht und über weitere geistige Schutzrechte vemittelt, sowohl im nationalen als auch im europäischen und weiteren internationalen Kontext.

Learning outcomes / competencies / targeted competencies:

Nach diesem Kurs sollten die Studierenden Kenntnisse haben unter anderem bezüglich

- Der Schutzvoraussetzungen für ein Patent, ein Design oder eine Marke
- Des Zwecks und der Vorteile von geistigen Schutzrechten
- Verletzungen geistigen Eigentums, insbesondere von Patenten
- Der Anmeldeverfahren für eine Patent,- Design- und Markenanmeldung
- Schutzstrategien für neue Entwicklungen
- Patentrecherchen

Calculation of student workload:

Are there optional courses in the modules?

no

Language(s) of instruction:

German

Responsible for the module:

Prof. Dr.-Ing. Kai Michels

Frequency:

summer semester, yearly

Duration:

1 semester[s]

The module is valid since / The module is valid until:

SoSe 20 / -

Credit points / Workload:

3 / 90 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:

Written examination

The examination is ungraded?

no

Number of graded components / ungraded components / prerequisites of the examination:

- / - / -

Language(s) of instruction:

German

Module courses

Course: Patente, Schutzrechte und geistiges Eigentum / Patents, Protective Rights and Intellectual Property

Frequency:
summer semester, yearly

Language(s) of instruction:
German

Contact hours:
2,00

Literature:
Unterlagen werden in der Vorlesung auf StudIP hochgeladen

Teaching format(s):
Lecture

Associated module examination:
Modulprüfung

Module 01-ET-MA-SoC(a): Systems on Chip: Architectures and Design Methods
Systems on Chip: Architectures and Design Methods

Assignment to areas of study:
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
Lectures "Architectures and Design Mehodologies of Integrated Digital Systems" and "Advanced Digital System Design" are recommended.

Learning content:
- Introduction to Systems-on-Chip
- Low-Power techniques for SoCs in nanometric technologies
- On-Chip nano-photonic communication
- 3D technologies
- Approximate computing

A list of references will be provided at the start of the semester.

Learning outcomes / competencies / targeted competencies:
The students acquire specialized knowledge about the architectures of modern Systems-on-Chip using heterogeneous technologies (e.g., electrical and photonic) and heterogeneous modules (e.g., processors, accelerators, analog components). They learn the implementation strategies and skills required for the implementation of those Systems-on-Chip in nanometric technologies. They are able to read critically, assimilate, and analyze current research papers regarding systems-on-chip.

Calculation of student workload:
50 h Preparation / follow-up work
42 h SWS / presence time / working hours
88 h Exam preparation

Are there optional courses in the modules?
no

Additional comments:
A list of references will be provided at the start of the semester.

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr.-Ing. Alberto Garcia-Ortiz

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Presentation, oral

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English / German

Description:
Anzahl Prüfungsleistung: 1

Module courses

Course: Systems on Chip: Architectures and Design Methods

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
3,00

Literature:
A list of references will be provided at the start of the semester.

Teaching format(s):
Lecture

Associated module examination:
Modulprüfung

Module 01-ET-MA-UGer-S: Understanding Germany
Understanding Germany

Assignment to areas of study:
- CMM Elective Modules / CMM Further Electrive Modules

Content-related prior knowledge or skills:
none

Learning content:

Learning outcomes / competencies / targeted competencies:

Calculation of student workload:

Are there optional courses in the modules?
no

Additional comments:
ECTS-Punkte für das Modul: 3 CP

Language(s) of instruction:
German

Responsible for the module:
Prof. Dr.-Ing. Björn Lüssem

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
2 / 60 hours

Module examinations

Module examination: Modulprüfung

Type of examination: module exam

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
German / English

Description:
Anzahl Prüfungsleistung: 1

Module courses

Course: Understanding Germany

Frequency:
winter semester, yearly

Language(s) of instruction:
German / English

Contact hours:
2,00

Teaching format(s):	Associated module examination:
Lecture	Modulprüfung

Module 01-ET-MA-CTh2(a): Control Theory 2 / Regelungstheorie 2
Control Theory 2

Assignment to areas of study:
- CMM Elective Modules

Content-related prior knowledge or skills:
Vorlesung „Regelungstheorie I“

Lecture „Control Theory I“

Learning content:
- Nullstellen von Mehrgrößensysteme
- Normen
- Entwurf von normoptimalen Regelungen
- Robustheit

- Zeros of Multi-Input-Multi-Output systems
- Norms
- Design of norm-optimal controllers
- Robustness

Learning outcomes / competencies / targeted competencies:
- Erweitertes Verständnis der Zustandsraummethodik für lineare Systeme
- Einblick in die Idee und den Entwurf von normoptimalen Regelungen

- Increasing the understanding of linear state space analysis and controller design
- Understanding the idea and the design of norm-optimal controllers

Calculation of student workload:
68 h Exam preparation
56 h Preparation / follow-up work
56 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
English / German

Responsible for the module:
Prof. Dr.-Ing. Kai Michels

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English / German (Vorlesungsskript liegt auf Deutsch und Englisch vor / A detailed script in German and English is available.)

Description:
Anzahl Prüfungsleisug: 1

Schriftlich oder mündlich, abhängig von der Teilnehmerzahl.

Written or oral, depending on the number of participants.

Module courses

Course: Control Theory 2

Frequency:
summer semester, yearly

Language(s) of instruction:
English / German (Ein detailliertes Vorlesungsskript liegt auf Deutsch und Englisch vor / A detailed script in German and English is available.)

Contact hours:
4,00

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung

Associated module courses

Control Theory 2 / Regelungstheorie 2 (Lecture)

Module 01-ET-MA-IoT(a): Internet of Things
Internet of Things

Assignment to areas of study:
- CMM Elective Modules

Content-related prior knowledge or skills:
Grundkenntnisse Kommunikationsprotokolle

Learning content:
The course will cover the core principles and technologies enabling modern IoT systems, with a focus on low-power and long-range connectivity solutions.

- **Basics of Wireless Communication:** Review of fundamental concepts.
- **Low-Power Wide-Area Networks (LPWAN):** Detailed study of **LoRa** and the **LoRaWAN** protocol stack, including architecture, classes, security, and applications.
- **Wireless Sensor Networks (WSN) & Low-Power Protocols:** Examination of low-power and constrained network protocols such as **6LoWPAN**, **RPL**, and **CoAP**.
- **Wireless Local Area Network (WLAN) & Personal Area Network (PAN) Standards:** coverage of **Wi-Fi (IEEE 802.11)** for IoT, and low-power standards like **Bluetooth Low Energy (BLE)**.
- **Fundamentals of Embedded Systems:** Embedded Operating Systems like **RIOT** and **Zephyr** and their applications.
- **Specific IoT Communication Protocols:** Overview of other relevant standards like **Zigbee**, **EnOcean**, **ISA100**, and **WirelessHART** in the context of specific IoT domains (e.g., Industrial IoT).
- **Advanced IoT Networking Concepts: Introduction to**
- **Energy requirements, optimization and evaluation** of energy-limited devices.

A list of references will be provided at the start of the semester.

Learning outcomes / competencies / targeted competencies:
This course covers a broad spectrum of protocols and concepts, including **Wireless Sensor Networks, Cyber-Physical Systems, Low-Power Wide-Area Networks (LPWAN)**, and **Industrial IoT (Industry 4.0)**. Upon successful completion of this course, the participant will be able to:

- **Name, describe, and differentiate** the relevant **low-power and long-range standards**
- **Evaluate** diverse **IoT applications** and critically determine their specific **requirements** regarding communication, power, costs etc.
- **Design and deploy** simple proof-of-concept embedded **IoT applications** using selected protocols like LoRa(WAN) or WiFi
- **Analyze and understand the current research challenges and future developments in the evolving area of IoT and embedded systems, especally concerning state-of-the art communication, energy requirements and - optimization and the overall system design.**

Calculation of student workload:
96 h Self-study
42 h Preparation / follow-up work
42 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr. Anna Förster

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Internet of Things

Type of examination: combination exam

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
3 / - / -

Language(s) of instruction:
English

Module courses

Course: Internet of Things

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
3,00

Teaching format(s):
Lecture
Project

Associated module examination:
Internet of Things

Associated module courses

Internet of Things (Lecture)

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Course: Internet of Thingss

Frequency:
summer semester, yearly

Language(s) of instruction:
German / English

Contact hours:
3,00

Teaching format(s):
Lecture
Project

Associated module examination:
Internet of Things

Module 01-ET-MA-MST(a): Microsystems
Microsystems

Assignment to areas of study:
- CMM Elective Modules

Content-related prior knowledge or skills:
Modul 01-ET-MA-SAMS(a): Sensors and Measurement Systems

Learning content:
The class covers the most important transducer concepts used in microsystems. In particular, the following topics will be discussed

- Application areas of microsystems, current trends
- Mechanics of microsystems: stress, strain, generalized Hooke's law, bending of beams and membranes
- Thermal transducers: thermal stress, hot arm actuator
- Piezoelectric transducers: piezoelectric effect, generalized Hooke's law with piezoelectric components, RF switch
- Piezoresistive transducers: piezoresistive effect, accelerometer
- Capacitive transducers: capacitive half-bridge, pull-in, applications of capacitive transducers
- Energy supply of microsystems

Learning outcomes / competencies / targeted competencies:
After the course students:

- can identify trends in microelectronics research,
- can design microsystems based on a thorough understanding of the mechanical properties of microsystems
- can choose the best transducers principle for a particular measurement and application
- can choose between different options for energy supply for microsystems

Calculation of student workload:
84 h Preparation / follow-up work
40 h Exam preparation
56 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Additional comments:
A list of references will be provided at the start of the semester.

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr.-Ing. Björn Lüssem

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English

Description:
Anzahl Prüfungsleistungen: 1

Module courses

Course: Microsystems

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
4,00

Literature:
A list of references will be provided at the start of the semester.

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung

Associated module courses

Microsystems (Lecture)

Microsystems (Lecture)

Module 01-ET-MA-SSc(a): Sensor Science
Sensor Science

Assignment to areas of study:
- CMM Elective Modules

Content-related prior knowledge or skills:
none

Learning content:
- Conduct a literature search
- Reading of scientific publications in the field of sensors
- Study specific aspects of sensor science through the found literature
- Write a report on the study
- Oral presentation

A list of references will be provided at the start of the semester.

Learning outcomes / competencies / targeted competencies:
Students are able to:

- conduct an efficient literature search,
- discriminate between the main and minor aspects of a research topic,
- study and understand the physical and electronic fundamentals of a specific sensor,
- report in word and in writing.

Calculation of student workload:
56 h Self-study
68 h Exam preparation
56 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr.-Ing. Michael Vellekoop

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English / German

Description:
Anzahl Prüfungsleistungen: 1

Module courses

Course: Sensor Science

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
4,00

Literature:
A list of references will be provided at the start of the semester.

Teaching format(s):

Associated module examination:
Modulprüfung

Associated module courses

Sensor Science (Lecture)

Sensor Science (Lecture)

Module 01-ET-MA-ScPr: Scientific Practice
Scientific Practice

Assignment to areas of study:
- CMM Elective Modules

Content-related prior knowledge or skills:
none

Learning content:
- Foundations of scientific work and practice
- Reading scientific texts and publications
- Publishing scientific texts
- Writing scientific reports and publications
- Planning, structuring and writing techniques
- Plagiarism and other issues and regulations

Learning outcomes / competencies / targeted competencies:
This seminar offers the basics of scientific practice. After this, participants will be able to self-responsibly write scientific reports and publications, document experiments and presenting their findings. Furthermore, they will understand the current trends and challenges of the scientific community. The seminar will be based on English texts, discussions will be mixed in English and German and examples will be given from various fields of natural sciences.

Calculation of student workload:
42 h Preparation / follow-up work
28 h SWS / presence time / working hours
20 h Exam preparation

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr. Anna Förster

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
3 / 90 hours

Module examinations

Module examination: Modulprüfung

Type of examination:

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English

Description:
Gemäß MPO-CIT-02-22 und AeO_MSc-CIT02-22 und MPO-CMM-02-22 und AeO_MSc-CMM-02-22 = Anzahl Prüfungsleistungen: 1

Successful elaboration and submission of report/ publication/thesis

Module courses

Course: Scientific Practice

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
2,00

Teaching format(s):

Associated module examination:
Modulprüfung

Associated module courses

Scientific Practice (Seminar)

Scientific Practice (Seminar)

Module 01-ET-MA-THsMSc: Masterarbeit
Master Thesis and Colloquium

Assignment to areas of study:
- *** MGnew ***

Content-related prior knowledge or skills:
ref. examination regulations

Learning content:
- Getting familiar with a specific research question and conduct of a literature search on the state of the art
- Development of a working plan
- Application of scientific methods in conducting and evaluating the research work
- Elaboration of own results
- Compilation and discussion of the results
- Presentation and defence of the results in a colloquium

Learning outcomes / competencies / targeted competencies:
The master's thesis is an autonomous piece of research work conducted under the guidance of a supervisor. The aim is to learn how to plan, to perform and to document scientific work. After the master's thesis, the student should be able to conduct research within industrial surroundings or within a PhD project.

Specifically competences gained in this module:

- Knowledge and experience in structuring a research question and organizing the work thereon
- The state-of-the-art knowledge in the specific research topic
- Skills in independent literature search, screening and evaluation
- Skills in compiling and discussing scientific outcomes in a written report
- Experience in presenting and defending the results

Calculation of student workload:
40 h Preparation / follow-up work
860 h Exam preparation

Are there optional courses in the modules?
no

Language(s) of instruction:
German / English

Responsible for the module:
N.N.

Frequency:
each semester

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 24 / -

Credit points / Workload:
30 / 900 hours

Module examinations

Module examination: Masterarbeit

Type of examination:

Form of examination:
Master Thesis

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
6 / - / -

Language(s) of instruction:
English / German

Description:
Type of examination: Masterarbeit, Kolloquium

Examination format: Master Thesis, Kolloquium

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Module examination: Kolloquium

Type of examination:

Form of examination:
Colloquium

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English / German

Description:
Type of examination: Masterarbeit, Kolloquium

Examination format: Master Thesis, Kolloquium

Module 01-ET-MA-0 CIT/CMM: Additional courses master program CIT/CMM
Additional courses master program CIT/CMM

Assignment to areas of study:
- Additional Courses

Content-related prior knowledge or skills:
none

Learning content:

Learning outcomes / competencies / targeted competencies:
In diesem "Modul", das nicht Bestandteil der Prüfungsordnung ist, informieren wir Sie über Veranstaltungen, die aufgrund der neuen Darstellungsstruktur in Stud.IP sonst nicht mehr auffindbar wären. Es können Seminare, Informationsveranstaltungen oder General Studies Angebote sein.
Sollten Sie erwägen, in einer der Veranstaltungen eine Prüfung abzulegen, erkundigen Sie sich bitte bei Ihrer Dozentin/Ihrem Dozenten über die korrekten Anmeldemodalitäten.

In this “module”, which is not part of the examination regulations, we inform you about courses that would otherwise no longer be visible in Stud.IP due to the new display structure. These may be seminars, information events or general studies courses.
If you consider taking an examination in one of the courses, please ask your lecturer about the correct registration modalities.

Calculation of student workload:

Are there optional courses in the modules?
yes

Language(s) of instruction:
German

Responsible for the module:
N.N.

Frequency:

Duration:

The module is valid since / The module is valid until:
WiSe 23/24 / -

Credit points / Workload:
30 / 900 hours

Module examinations

Module examination: ohne Prüfung

Type of examination: module exam

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
yes

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
German

Module courses

Course: Additional courses master programm CIT/CMM

Frequency:

Language(s) of instruction:
German

Contact hours:
0,00

Teaching format(s):
Lecture
Tutorial
Seminar
Study group
Self-study unit

Associated module examination: