DEGGENDORF INSTITUTE OF TECHNOLOGY

Electives
Master Automotive Software Engineering
Winter Semester

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Electives
Master Automotive Software Engineering
Winter Semester

Generell Information

This module handbook applies to electives offered in winter semester 2025. The listed modules can be chosen for Elective 1 or 2. For the winter semester, there is a separate list/module handbook

Important: If German is specified as the language of instruction for an elective course, then the examination will also be conducted in German!

AIX-B-22 Process Mining

Module code	AIX-B-22
Module coordination	Prof. Dr. Claudia Nuber
Course number and name	AIX-B-22 Process Mining
Lecturer	Prof. Dr. Claudia Nuber
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	elective course
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 90 hours self-study: 60 hours Total: 150 hours
Language of Instruction	German

Module Objective

AIX-M-18 Basics of FPGA SoC Development

Module code	AIX-M-18
Module coordination	Jonas Wühr
Course number and name	AIX-M-18 Basics of FPGA SoC Development
Lecturer	Jonas Wühr
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	compulsory course
Level	Postgraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Weighting of the grade	
Language of Instruction	English

Module Objective

Professional skills:

The aim is to gain system understanding of System on Chip (SoC) components combining a FPGA block, a CPU and peripheral components on one chip.

Methodological skills:

The students learn a basic workflow for developing software and logic for FPGA SoCs and have the chance to apply their knowledge during a comprehensive final project.

Personal and social skills:

The students train their skills in professional cooperation by working on problems in groups.

Entrance Requirements

Basic VHDL and C programming skills

Learning Content

- Overview of FPGA SoC concepts
- Standardized FPGA component interfaces (AXI4 and DMA)
- Embedded Linux (Yocto, Device Tree)
- Kernel driver development for FPGA SoCs
- FPGA IP core design for SoCs (Design patterns and timing analysis)
- Exemplary deepening of the topics based on the AMD ZYNQ-7000 SoC

Teaching Methods

Seminar based teaching combined with lab sessions

Recommended Literature

[1] Crockett, L. H.; Elliot, R. A.; Enderwitz, M. A.; Stewart, R. W.: The Zynq Book - Embedded Processing with the ARM Cortex-A9 on the Xilinx Zynq-7000 All Programmable SoC, 2014, First Edition, Strathclyde Academic Media, ISBN: 9780992978709
[2] Bootlin: Linux Kernel and Driver Development - Practical Labs. 2018, ISBN: 9781719118781
[3] Vasquez, F.; Simmonds, C.: Mastering Embedded Linux Programming - Third Edition, 2021, ISBN: 9781789530384
[4] Readler, B.: VHDL BY EXAMPLE: A concise introduction for FPGA design, 2014, ISBN: 9780983497356
[5] Readler, B.: VERILOG BY EXAMPLE: A concise introduction for FPGA design. 2011, ISBN: 97809834973

MET-15 Special Topics of Contactless Sensor Systems

Module code	MET-15
Module coordination	Prof. Dr. Simon Zabler
	Automatisierungstechnik (AT)
Course number and name	MET 2107 Special Topics of Contactless Sensor Systems
Lecturer	Prof. Dr. Simon Zabler
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Postgraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	5/90
Language of Instruction	English

Module Objective

The students achieve the following learning objectives:
Professional Skills

Students gain a thorough knowledge and a deep understanding of modern contactless sensors and sensor systems, especially of optical sensors

Methodological Skills

They learn to evaluate different tasks of industrial projects, when contactless measurements can help solving the problem.

The students develop a deep understanding of finding strategies for solving these problems, especially by applying analog and digital image processing techniques.

Soft Skills

The students learn to apply these strategies successfully in special case studies with problems, which they have solve e.g. during their master thesis and their projects in industry jobs.

Applicability in this and other Programs

For this degree program:

Compulsory subject within Master-Program Electrical Engineering and Information Technology, focus automation engineering (AT)

For any other degree program:

Elective for Master Applied Research in Engineering Sciences

Entrance Requirements

Formally: none

In terms of content: Deep knowledge of basic mathematics and its scientific and technical application, in particular trigonometry, coordinate systems, vector analysis, matrix calculus, differential and integral calculus, geometric transformations, fitting and interpolation techniques.
Deep knowledge of basic physics and its scientific and technical application in particular generation, transfer and measurement of electromagnetic radiation, in particular from the visible part of the spectrum.

Learning Content

Basics of sensor principles using geometrical optics (e.g. triangulation, image acquisition and image preprocessing)

Basics of sensor principles using electromagnetic radiation transfer (e.g. time of flight measurement, thicknesss measurement, photometry, fluorescence, interferometry, light barriers and light scanners)

Basics of sensor principles using electromagnetic radiation detection (e.g. photomultiplier, photo sensors, CCD and CMOS sensors)

Case studies of sensor application: Machine vision applications using image acquisition, image preprocessing and image processing

Teaching Methods

Lectures, practical exercise (software workshops), laboratory work

Recommended Literature

C. Demant et al: Industrial Image Processing bzw. Industrielle Bildverarbeitung, Springer.

R. Gonzalez / R. Woods: Digital Image Processing, Prentice Hall.

J. Haus: Optical Sensors, Wiley-VCH.

S. Hesse / G. Schnell: Sensoren für die Prozess- und Fabrikautomation, Vieweg.

A. Hornberg (editor): Handbook of Machine Vision, Wiley-VCH.

B. Jähne: Digital Image Processing bzw. Digitale Bildverarbeitung, Springer.

R. Jain / R. Kasturi, B.G / Schunck: Machine Vision, McGraw-Hill Book Company.

J. Niebuhr / G. Lindner: Physikalische Messtechnik mit Sensoren, Oldenbourg.

M. Petrou / P. Bosdigoianni: Image Processing, John Wiley & Sons.

E. Schiessle: Industriesensorik, Vogel Verlag.

C. Solomon / T. Breckon: Fundamentals of Digital Image Processing.

C. Steger / M. Ulrich / Chr. Wiedemann: Machine Vision Algorithms and Applications, Wiley-VCH.

MET-17 Advanced Automation

Module code	MET-17
Module coordination	Prof. Dr. Terezia Toth
	Automatisierungstechnik (AT)
Course number and name	MET 2109 Advanced Automation
Lecturers	Martin Fischer Prof. Dr. Terezia Toth
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Postgraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	5/90
Language of Instruction	English

Module Objective

In the subject Advanced Automation students obtain an overview on how programmable logic controllers (PLCs) work, as well as basic hardware and software requirements. They learn the standardized (IEC61131-3) and manufacturer-specific (TIA Portal) programming options. They learn how to use visualization software for the user interface. The students acquire the basic competence to understand automated processes in the automotive industry, power plants, chemical industry, building technology and transportation. Thusthe students are able to shape the digital transformation of the industry.

The students achieve the following learning objectives:
Professional Skills

The students are familiar with the concepts and components of a modern automation system including the structure and functionality of industrial communication systems, also with regard to safety and security.
They are able to analyze, classify and solve simple tasks in automation technology.
The students know the requirements of hardware and software for a Programmable Logic Controller (PLC). They know the structure and the way a PLC operates. They are able create PLC programs. By using visualization software they can demonstrate the processes.

Methodological Skills

The application-oriented knowledge allows the students to compare advantages and disadvantages of the individual industrial bus systems, to examine in contrast the advantages and disadvantages of the individual programming languages to find optimal solutions.

Soft Skills

The students work on problems in a focused and independent way.
They can communicate their solutions both verbally and in writing in appropriate technical language.
They learn from mistakes, can assess and improve their own abilities.
They are able to work actively as a team.

Applicability in this and other Programs

For this degree program:

Compulsory subject within Master-Program Electrical Engineering and Information Technology, key focus automation (AT)

For other degree program:

Master Program: Applied Computer Science

Elective for Master Applied Research in Engineering Sciences

Entrance Requirements

Formally: none

In terms of content: Basic knowledge of automation

Learning Content

1. Function of SPS

   - 1.1 Hardware requirements
   - 1.2 Current embodiments
   - 1.3 Environmental conditions
   - 1.4 Real-time requirements
- 2 Programming languages
- 3 Presentation of automation technology with regard to industrial communication
   - 3.1 ISO / OSI model in industrial communication
   - 3.2 Automation pyramid
   - 3.3 Vertical communication
   - 3.4 Structure and functionality of common comunication systems

Teaching Methods

Seminars with practical experience

Recommended Literature

R. Laubner / P. Göhner: Prozessautomatisierung I. Springer Verlag 1999.
G. Wellenreuther / D. Zastrow: Steuerungstechnik mit SPS, Springer/Vieweg 2015.
G. Wellenreuther: Automatisieren mit SPS - Übersichten und Übungsaufgaben, Springer/ Vieweg 2015.
K. John / M. Tiegelkamp: SPS-Programmierung mit IEC, Springer Verlag 2009.
G. Schnell: Bussysteme in der Automatisierungstechnik, 4. Auflage. Vieweg Verlag 2000.
W. Kriesel / O. Madelung: AS-Interface ? Das Aktuator-Sensor-Interface für die Automation. Hanser Verlag 1999.
M. Popp: Profibus-DP/DPV1, 2. Auflage. Hüthig Verlag 2000.
M. Popp: Das PROFINET IO-Buch: Grundlagen und Tipps für Anwender, 2. Auflage. VDE Verlag 2010.
Ausbildungsunterlagen der Fa. Siemens: www.siemens.com/global/de/home/ unternehmen/nachhaltigkeit/ausbildung/sce.html

MMC-04 Case Study Cooperative and Autonomous Systems

Module code	MMC-04
Module coordination	Ginu Alunkal
Course number and name	MMC1004 Case Study Cooperative and Autonomous Systems
Lecturer	Ginu Alunkal
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	postgraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Weighting of the grade	5 out of 90 ECTS
Language of Instruction	English

Module Objective

The module " **Case Study Cooperative and Autonomous Systems** " enables students to apply the knowledge acquired within the module " **Autonomous Systems** ", to deepen it independently and to work on and analyse subject-relevant application examples in a team.

Professional competence:

- Understanding and applying methods of autonomous systems
- Modelling of environmental conditions and vehicle relations
- Applying the methods for the localization of vehicles in space

- Application of methods for obstacle recognition and route planning
- Analysis of control loops for autonomous systems
- Understanding and Applying Denavit-Hartenberg Relationships
- Understanding and applying forward and inverse kinematics
- Application of robot simulations and programming of robots
- Understanding and applying the functions for joint collaboration between robots and humans.
- Understanding and applying methods of machine learning, in particular artificial intelligence
- Understanding different approaches to building assembly lines

Methodological competence:

- Application of robot programming
- Verification (evaluation) of robot movements
- Application of localization, navigation, route planning, and obstacle detection of autonomous systems
- Application of calculated robot relations in suitable simulation systems

Personal competence:

The "Case Study Cooperative and Autonomous Systems" teaches students how to solve complex robotic problems and how to use them as autonomous systems in groups with distributed tasks. The students learn how to analyze, apply and evaluate a task in relation to autonomous systems.

Social competence:

Students are able to view autonomous systems on the basis of case studies and to deepen and use their competences acquired from the module in group work.

Applicability in this and other Programs

Interfaces to mechatronics, control engineering, electrical engineering and computer science.

Entrance Requirements

Bachelor's degree in mechatronics, mechanical engineering, electrical engineering, industrial engineering, technical physics or computer science

Learning Content

On the basis of a selected application example, students are supposed to carry out independ literature research, if necessary independent small subtasks,etc. and work on the topic themselves by means of literature research.

Sample Autonomous Systems

- Characteristics of the required control loops of networked systems
- Sensors / actuators for vehicle control
- Localization and Mapping
- Route planning, tracking and obstacle detection
- ...

The case studies are examined as so-called examination papers, i.e. no classical examination.

Teaching Methods

Guided processing of seminar topics in study groups. Accompanying events / presentations depending on the selected topic area.

Remarks

The students learn to analyze and apply theoretical knowledge about the topics of the case study independently. This intensifies the transfer of knowledge into practice and the targeted deepening of the acquired technical and methodological competencies by recognizing contexts and evaluating them.

Recommended Literature

- Siciliano B., Khatib O.: Handbook of Robotics. Springer.
- Corke P.: Robotics, Vision and Control. Springer.
- Craig J. J.: Introduction to Robotics. Pearson Education.
- Spong M. W.: Robot Modeling and Control. Wiley.
- Siegert H. J., Bocionek S.: Robotik: Programmierung intelligenter Roboter. Springer.
- Brillowski Klaus: Einführung in die Robotik - Auslegung und Steuerung serieller Roboter. Shaker-Verlag.

MMC-03 Autonomous Systems

Module code	MMC-03
Module coordination	Prof. Dr. Dmitrii Dobriborsci
Course number and name	MMC1003 Autonomous Systems
Lecturers	Prof. Dr. Dmitrii Dobriborsci N.N.
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	postgraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	5 out of 90 ECTS
Language of Instruction	English

Module Objective

The contents of the module **Autonomous Systems** enable students to apply advanced knowledge in robotics focusing on the basics of robotics. Networking with autonomous systems supports the application-oriented teaching of the methodology and professional competence of robotics.

After completing the Autonomous Systems module, students will be able to

- Develop application-oriented solutions from the acquired methods for autonomous systems with regard to localization, navigation, route planning, obstacle recognition and tracking;

- Analyze and apply robotic methods in a targeted manner;
- Using the generated methods in simulation models.

Within the module **Autonomous Systems** , the following competences are to be taught:

Professional competence:

- Understanding and applying methods of autonomous systems
- Modelling of environmental conditions and vehicle relations
- Applying the methods for the localization of mobile robots
- Application of methods for obstacle recognition and path planning
- Analysis of control loops for autonomous systems
- Understanding and applying Denavit-Hartenberg Relationships
- Understanding and applying forward and inverse kinematics
- Application of robot simulations and programming of robots

Methodological competence:

- Application of robot programming
- Verification (evaluation) of robot motions
- Application of localization, navigation, path planning, and obstacle detection of autonomous systems
- Application of calculated robot relations in suitable simulation systems

Personal competence:

- Solution of complex robotics topics and their application as autonomous systems

Social competence:

- Students are able to look at autonomous systems and to deepen and use the competences acquired in the module in a prepared way.

Applicability in this and other Programs

The module provides the necessary theoretical knowledge and transfer possibility for the application of autonomous system to provide irrespectively of the mobility platform for different application scenarios. Interfaces to mechatronics, control engineering, electrical engineering and computer science result.

Entrance Requirements

Bachelor's degree in mechatronics, mechanical engineering, electrical engineering, industrial engineering, technical physics or computer science.

Basic knowledge and experience in Python are necessary for the second part of the lab-sessions. However, students with prior experience in Matlab, R or other programming languages may be acceptable given an introductory Python tutorial outside of the module.

Also knowledge of linear algebra and calculus are expected.

Learning Content

Within the framework of the module " **Autonomous Systems** ", students deal with in-depth contents of mobile and collaborative robotics. 3D obstacle / object recognition, localization and map generation, as well as navigation and route planning play a decisive role. Cognitive systems, machine learning and artificial intelligence are also addressed.

Teaching Methods

Seminaristic teaching with joint exercises to deepen the theory learned through application

Recommended Literature

- Siciliano B., Khatib O.: Handbook of Robotics. Springer.
- Corke P.: Robotics, Vision and Control. Springer.
- Craig J. J.: Introduction to Robotics. Pearson Education.
- Spong M. W.: Robot Modeling and Control. Wiley.
- Siegert H. J., Bocionek S.: Robotik: Programmierung intelligenter Roboter. Springer.
- Brillowski Klaus: Einführung in die Robotik - Auslegung und Steuerung serieller Roboter. Shaker-Verlag.

VECTOR

VECTOR certified

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Automotive Embedded Software Development and beyond.

CEA AUTOSAR Classic

Value 3022€

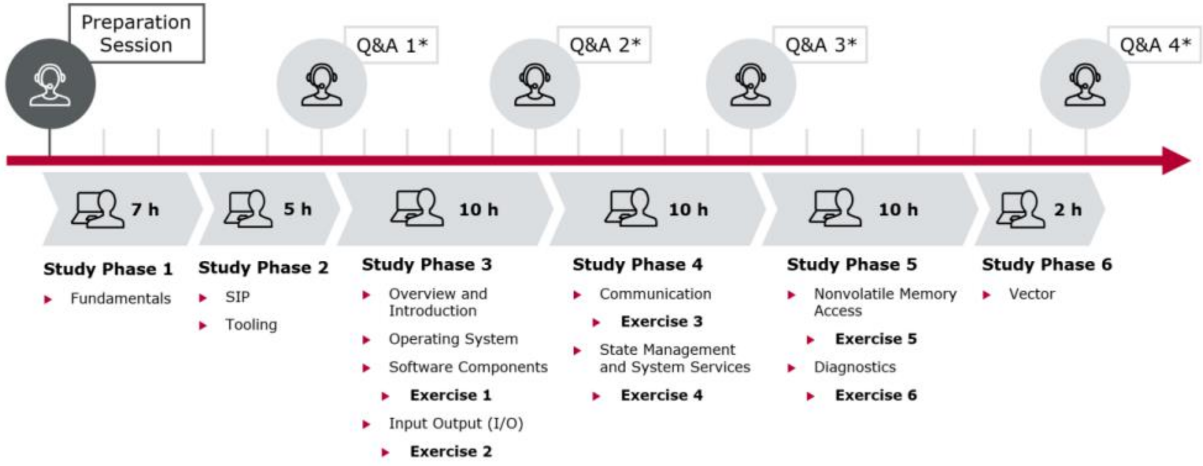
Learn all about the **AUTOSAR Classic Platform methodology**, the technical concepts as well as the operation of the RTE and the basic software components. Gain first hands-on experience with the Vector BSW and toolchain.

Prerequisite: C-Coding Skills

Who can join ? App. Developer, Software Component Tester, Prj. Leader, Entry Level Engineers, AUTOSAR ECU Developers

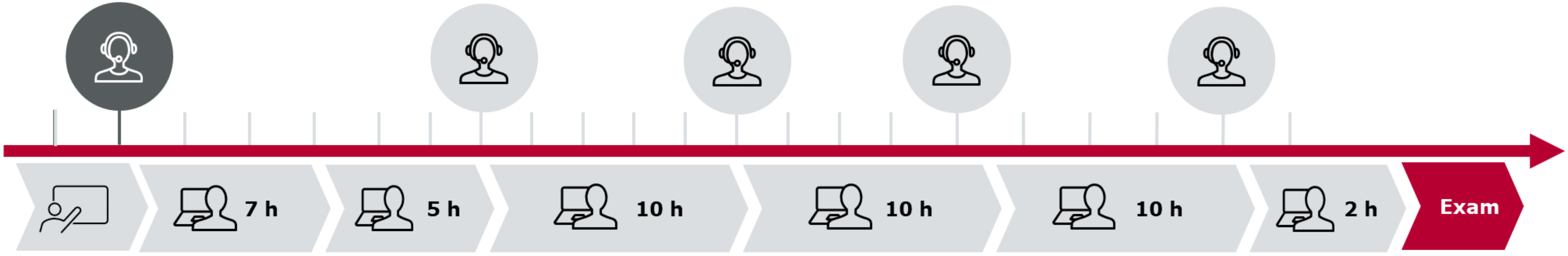
Duration: 44h self study + 11h remote sessions

Download Agenda



* For organizational reasons, the distribution of Q&A sessions may deviate slightly from this schedule. In this case, please refer to the session invitations for orientation. Of course, you can assume that the sessions are planned in such a way that an optimal learning progress is nevertheless made possible.

Time Schedule



Intro-ducation

Study Phase 1
- Vector Products
- Fundamentals

Study Phase 2
- SIP
- Tooling

Study Phase 3
- Operating System
- Software Components
  - **Exercise 1**
- Input Output (I/O)
  - **Exercise 2**

Study Phase 4
- Communication
  - **Exercise 3**
- State Management and System Services
  - **Exercise 4**

Study Phase 5
- Nonvolatile Memory Access
  - **Exercise 5**
- Diagnostics
  - **Exercise 6**

Study Phase 6
- Vector

- **Time Schedule**
  - 8-10 weeks in part time
  - Total estimated effort: ~45h + individual learning effort
- **Success factors:**
  - Studies in Computer science, electrical engineering or similar
  - Master students or Bachelor students > 4th semester
  - Good programming knowledge in C