TECHNISCHE HOCHSCHULE DEGGENDORF

Module Guide
Automotive Software Engineering

Faculty Computer Science
Examination regulations 24.04.2024
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Table of Contents

ASE-01 Computervision

Module code	ASE-01
Module coordination	Prof. Dr. Marcus Barkowsky
Course number and name	ASE-01 Computervision
Lecturer	Prof. Dr. Marcus Barkowsky
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	project work
Weighting of the grade	5/210
Language of Instruction	English

Module Objective

The aim of this class is to discuss Computer Vision (CV), which allows computers to process visual inputs. We deal every day dozens of times with CV, such as facial recognition, real-time translating camera input or auto-tagging friends in photos. Modern CV algorithms are strongly based on machine learning methods, in particular deep neural networks. Students will acquire knowledge in CV and be able to elaborate it further in the future, for example in projects or further studies. Overall, CV is a cutting-edge eld, with many high-pay opportunities for graduates.

Specifically, students will have achieved the following learning outcomes upon completion of the module:

Subject competency

Students will understand the concepts of the most common methods in computer vision. (2 - Understanding)

Methodological competency
Students will have the ability to develop high-quality programs using computer vision technologies. (3 - Apply)

Personal competency
Students will be able to implement their own algorithms and defend them against competing approaches. (6 - Create)

Social competency
Programming exercises take place as part of the course. Students are thus able to understand, critique, and complement programs of other students. (5 - Assess)

Applicability in this and other Programs

Including, but not limited to, the following modules:

- AI Project
- Deep Learning/Big Data

Entrance Requirements

- Programming, ideally in Python
- Algorithms and data structures
- (Some) mathematics

Learning Content

- Introduction: applications, computational models for vision, perception and prior knowledge, levels of vision, how humans see
- Pixels and filters: digital cameras, image representations, noise, filters, edge detection
- Regions of images and segmentation: segmentation, perceptual grouping, Gestalt theory, segmentation approaches, image compression
- Feature detection: RANSAC, Hough transform, Harris corner detector
- Object recognition: challenges, template matching, histograms, machine learning
- Convolutional neural networks: neural networks, loss functions and optimization, backpropagation, convolutions and pooling, hyperparameters, AutoML, efficient training, selected architectures
- Image sequence processing: motion, tracking image sequences, Kalman filter, correspondence problem, optical flow

- Foundations of mobile robotics: robot motion, sensors, probabilistic robotics, particle filters, SLAM
- Outlook: 3D vision, generative adversarial networks, self-supervised learning, vision transformers

Teaching Methods

- Lectures
- Projects

Remarks

In dual study programs, the transfer of theory into practice is promoted in this module through the close integration of theoretical teaching content and practical experience. Students have the opportunity to apply and reflect on what they have learned in class directly in their professional environment. This enables effective skills acquisition, as theoretical knowledge is deepened and consolidated through practical application. In addition, the content of the examination is usually tailored to the practical content of the company.

Recommended Literature

- C. Bishop and H. Bishop, " Deep Learning: Foundations and Concepts ", Springer, 2024.
- R. C. Gonzalez and R. Woods, " Digital Image Processing ", Pearson, 4th edition, 2018.
- I. Goodfellow, Y. Bengio and A. Courville, " Deep Learning ", MIT Press, 2016.
- S. Russell and P. Norvig, " Artificial Intelligence: A Modern Approach ", Pearson, 4th edition, 2021.

ASE-02 Digital Car / Innovation Management & Customer Design

Module code	ASE-02
Module coordination	Prof. Dr. Markus Straßberger
Course number and name	ASE-02 Digital Car / Innovation Management & Customer Design
Lecturer	Prof. Dr. Markus Straßberger
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	project work
Weighting of the grade	5/90
Language of Instruction	English

Module Objective

Understanding of working methodologies in automotive pre-development and research.

Understanding of dependencies and correlations between various architecture, technology, and design decisions.

Understanding of different innovation phases, including their boundary conditions, methods, as well as advantages and disadvantages.

Understanding of Design Thinking and customer-centric perspectives.

Application to real-world innovation decisions (or: Applying knowledge to real-world innovation challenges).

Applicability in this and other Programs

Master Automotive Software Engineering, Master Applied Research, Master Electrical Engineering

Entrance Requirements

none

Learning Content

In this lecture, you will acquire profound competencies in the field of innovation management, with a clear focus on transferring theoretical knowledge into practical problem-solving skills. The content is structured as follows:

In the first part, the theoretical foundations and frameworks are explained in detail to establish a deep understanding of the concepts (Level: Understanding).

In the second part, the transition to the practical level takes place: Through intensive group work, you will immediately apply what you have learned to a concrete innovation problem.

The objective is for you to not only reproduce the theory but to confidently master the methods for analysis and solution development within a realistic scenario (Level: Applying).

Teaching Methods

Part 1: Interactive Lecture

Part 2: Problem-Based Learning (PBL), Design Thinking / Ideation Workshops, Peer Feedback

Remarks

Part 2 will be held partially as an intensive block course at the Technology Campus Plattling

Recommended Literature

Script

ASE-02 Digital Car / Innovation Management & Customer Design

Objectives

Understanding of working methodologies in automotive pre-development and research.

Understanding of dependencies and correlations between various architecture, technology, and design decisions.

Understanding of different innovation phases, including their boundary conditions, methods, as well as advantages and disadvantages.

Understanding of Design Thinking and customer-centric perspectives.

Application to real-world innovation decisions (or: *Applying knowledge to real-world innovation challenges*).

Entrance Requirements

none

Learning Content

In this lecture, you will acquire profound competencies in the field of innovation management, with a clear focus on transferring theoretical knowledge into practical problem-solving skills. The content is structured as follows:

- In the first part, the theoretical foundations and frameworks are explained in detail to establish a deep understanding of the concepts (Level: Understanding).
- In the second part, the transition to the practical level takes place: Through intensive group work, you will immediately apply what you have learned to a concrete innovation problem.

The objective is for you to not only reproduce the theory but to confidently master the methods for analysis and solution development within a realistic scenario (Level: Applying).

Type of Examination

project work

Methods

Part 1: Interactive Lecture

Part 2: Problem-Based Learning (PBL), Design Thinking / Ideation Workshops, Peer Feedback

Recommended Literature

Script

ASE-03 Advanced Driver Assistance Systems

Module code	ASE-03
Module coordination	Prof. Thomas Limbrunner
Course number and name	ASE-03 Advanced Driver Assistance Systems
Lecturer	Prof. Thomas Limbrunner
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 ECTS
Language of Instruction	English

Module Objective

Students are given a basic overview of the systematics of driver assistance systems and the interaction of the components involved. The aim is to gain an overall system understanding of the topology in the vehicle and to highlight the key aspects of the development and function of driver assistance systems.

Applicability in this and other Programs

Master Automotive Software Engineering, Master Applied Research, Master AI, Bachelor Cybersecurity, B-AI, MT-B, M-AID

Entrance Requirements

Undergraduate studies

Learning Content

- Overview of driver assistance systems (definition, classification of relevant terms, classification, areas of application, legal aspects,
  NCAP, ...)
- System overview of the vehicle from the perspective of driver assistance, understanding the functional chains, K-matrix,
  mapping of signals
- Sensor technology, measurement and functional principle, such as camera (mono, stereo), lidar, radar, ultrasound, EGO data
- Central vehicle computer, domain controller, sensor fusion

Note: The content of the course may change over time and will be continuously adapted to current technological developments

Teaching Methods

Seminar based teaching combined with practical blocks, as well as some group work or research with presentation of results

Recommended Literature

[1] Winner, H.; Hakuli, S.: "Handbuch Fahrerassistenzsysteme"
Springer Vieweg Verlag 2012, 2015, 3. Auflage, ISBN: 978-3-658-05733-6
[2] Reif, K.: "Automobil Elektronik", Vieweg Verlag 2006, 1. Auflage, ISBN 3-528-03985-X
[3] Streichert, T.; Traub, M.: "Elektrik/Elektronik Architekturen im Kraftfahrzeug",
Springer Vieweg Verlag 2012, ISBN: 978-3-642-25478-9
[4] Schäufele, J.; Zurawka, T.: "Automotive Software Engineering",
Vieweg Verlag 2003, ISBN: 3-528-01040-1

ASE-03 Advanced Driver Assistance Systems

Type of Examination

Portfolio

ASE-04 Mobile applications & interaction design in vehicle

Module code	ASE-04
Module coordination	Prof. Dr. Goetz Winterfeldt
Course number and name	ASE-04 Mobile applications & interaction design in vehicle
Lecturer	Prof. Dr. Goetz Winterfeldt
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: 90 hours self-study: 60 hours Total: 150 hours
Type of Examination	Portfolio
Weighting of the grade	5 ECTS
Language of Instruction	English

Module Objective

Students learn how to make use of Android Studio in order to programm mobile applications to be used in the automotive are. In addition students learn how to make use of interaction design (using different options to communicate with the car). Students are realizing a project and make use of different protocols in order to implement a defined use case.

In a project students realize a project: hardware is communicting with a android based system. Students work with hardware and software and get the competences to integrate different sensors and actors.

Students learn to describe a project, present the idea and present the realized project to the oterh students.

Applicability in this and other Programs

The subject can be used in other technical study programms (master niveau).

Entrance Requirements

Knowledge in the area of programming. Knowledge in the are of microcontrollers.

Learning Content

asics and Pracis:
(1) Introduction Interaction Design
(2) OBD Protocol
(3) Programming Android (Automotive)
(4) Microcontroller (Sensor and Interactionmodules)
Project:
(1) Describtion (topic, architectur, sensors, actors) and presentiation of the project
(2) Realisation of the project using Android Studio and Hardware (CC3200 or other controller boards)
(3) Presentation, documentation and evaluation of the project using Google Forms and latex

Teaching Methods

The course is combining practical work using android studio and controller environments with lectures introducing the topics. When students are prepared students realize a project using their own infrastructure. The project is presented and evaluated by the other students using open evaluation platforms.

Recommended Literature

Automotive Interaction Design, **Fang Chen** , **Jacques Terken, Springer Verlag**
Automotive Human-Machine Interaction (HMI) Evaluation Method, **Jun Ma** , **Zaiyan Gong**
Android Application Development All-in-One for Dummies: Barry Burd/ John Paul Mueller

ASE-04 Mobile applications & interaction design in vehicle

Type of Examination

Portfolio

ASE-05 Compulsory Language: German or Other Foreign Language

Module code	ASE-05
Module coordination	Tanja Mertadana
Course number and name	ASE-05 Compulsory Language : German or Other Foreign Language
Lecturer	Dozierende für AWP und Sprachen
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Postgraduate
Semester periods per week (SWS)	4
ECTS	4
Workload	Time of attendance: 60 hours self-study: 60 hours Total: 120 hours
Type of Examination	See examination schedule AWP and languages
Weighting of the grade	4/90
Language of Instruction	Course dependent
	*Internationale Studierende erhalten ECTS ab der Niveaustufe Deutsch B1/ 1. + 2. Teil. Deutsch-Muttersprachler oder internationale Studierende mit Deutschkenntnissen der Niveaustufe C1 gemäß dem Gemei

Module Objective

The module Technical Language: German or Other Foreign Language aims to equip students with specialised language skills necessary for independent professional activity in the globalised field of automotive software engineering. To this end, students familiarise

themselves with the respective language in order to use it effectively and efficiently as a practical means of communication.
International students receive ECTS as of level German B1/ part 1 + 2. German native speakers or international students with German language skills at level C1 according to the Common European Framework of Reference for Languages can select any two foreign language courses from the catalogue of the Language Centre. Since English level B2 is an admission requirement, English can only be selected at level C1.

Qualification objectives can be found in the corresponding course description on the homepage of the Language Centre:
https://th-deg.de/language-and-electives-centre

Applicability in this and other Programs

Applicable in other degree programmes.

Entrance Requirements

In order to attend advanced language courses, students need to present the required language skills (e.g. by successfully completing of the previous level).

Learning Content

The course content can be found in the corresponding course description on the homepage of the Language Centre:
https://th-deg.de/language-and-electives-centre

Teaching Methods

The teaching methods applied will focus on optimising the four main language skills (listening, speaking, reading and writing). Examples of the applied learning methods include various forms of group, individual and collaborative work, mini-presentations, exercises involving intensive reading and listening, role plays and grammar games, loci method, dictation exercises, translations, peer feedback, working with learning stations, and various writing activities designed to consolidate the content learnt.

Students will be given weekly assignments for self-study.

Remarks

For course-specific details, please refer to the corresponding course description on the homepage of the Language Centre:
https://th-deg.de/language-and-electives-centre

All language courses require a compulsory attendance rate of 75% in order to be allowed to take the examination.

Recommended Literature

Recommended reading can be found in the corresponding course description on the homepage of the Language Centre:
https://th-deg.de/language-and-electives-centre

ASE-05 Compulsory Language : German or Other Foreign Language

Type of Examination

See examination schedule AWP and languages

ASE-06 Compulsory optional subject 1

Module code	ASE-06
Module coordination	Dozierende des ausgewählten Moduls Instructor for the selected module
Course number and name	ASE-06 Compulsory optional subject 1
Lecturer	Dozierende des ausgewählten Moduls Instructor for the selected module
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	elective 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	Examination form of the chosen module
Weighting of the grade	5/90
Language of Instruction	English

Module Objective

This module allows students to customize their curriculum by choosing an elective out of existing university courses

The main goal is to fill knowledge gaps of the student (individuality), to acquire knowledge in current and different upcoming topics (flexibility) and the students should be able to advance in individual higher-level topics (specialization). In connection with three other electives and two language modules in the curriculum, the module offers a high degree of individuality, flexibility and specialization.

The students achieve the following learning objectives in the module:

Professional skills

The students have closed their previously identified knowledge gaps with regard to the fields of AI, mathematics for AI, data science and software development.

Methodological skills

They can apply knowledge and field-specific methods not covered by regular modules listed in this document. Also, the students collect experience in independent the work on scientific research questions.

Soft skills

The students can give constructive feedback to peers in context of peer-assessed exercises.

Since courses from other programs can be selected for the elective, the respective study and examination regulations must be consulted for module information. Further, student research projects provided by faculty staff are described by the staff once electives have to be chosen for a semester. The descriptions of university courses and projects enhance the description of this module.

Applicability in this and other Programs

no applicable

Entrance Requirements

Fundamental knowledge in:

- undergraduate mathematics
- undergraduate computer science
- programming languages (Python, R, Java, C, C++, C# etc.)
- literature research and scientific working

Learning Content

In the case of a course chosen as elective, the learning content follows the course content.

The list of electives 1 contains the following modules. A detailed description can be found on iLearn and the DIT website.

- AIX-M-2 / Datacenter Network Programming / Prof. Kassler / EN /4 SWS / 5 ECTS
- LSI-M / Data Visualization / Prof. Torkler/ Prof. Valdes / EN /4 SWS / 5 ECTS
- HPC-M-7 / HPC/QC Technology / Prof. Liebelt / EN /4 SWS / 5 ECTS
- AIX-M-16 / ChatGPT et al.: Generative AI with Transformers / Prof. Fischer / EN /4 SWS / 5 ECTS

Teaching Methods

Course-based electives involve seminar-style lessons and may contain exercises. Student research projects rely on self-learning by doing literature research, data-science analyses and the development of algorithms or models

Remarks

This course is taught at the Deggendorf Institute of Technology.

The type and duration of examination in this module depends on the chosen elective, such as a course or a student research project. This means that the examination can be a written/oral exam or an examination paper submitted by the student.

Recommended Literature

The fundamental literature of each elective is provided by study and examination regulation and the respective lecturer. However, this also includes literature research done by the student in case of student research projects.

ASE-06 Compulsory optional subject 1

Type of Examination

Examination form of the chosen module

ASE-07 Artificial Intelligence and Software Development

Module code	ASE-07
Module coordination	Prof. Dr. Thomas Ewender
Course number and name	ASE-07 Artificial Intelligence and Software Development
Lecturer	Prof. Dr. Thomas Ewender
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	Portfolio
Weighting of the grade	5/90
Language of Instruction	English

Module Objective

The goal of this module is to provide an overview of current applications of artificial intelligence in the automotive sector. This is achieved on the one hand through lectures and group work, and on the other hand through project work with embedded systems, in which relevant applications are implemented as examples. Specifically, upon completion of the module, students will have achieved the following learning outcomes:

Professional Competence
Students understand current trends and topics in the field of artificial intelligence in the automotive sector. (**Level 2 Understand**)

Methodological Competence

Students are able to analyze trends and technical developments, comprehend them, and prepare them in a way that is understandable for others. (**Level 4 Analyze**)

Personal Competence
Students work in teams to produce results and generate summaries of current topics in the field of artificial intelligence in the automotive sector. (**Level 6 Create**)

Social Competence
Students can present knowledge developed in teams and convey it to other students. (**Level 2 Understand**)
Students discuss the results of their project work and are able to evaluate and defend them. (**Level 5 Evaluate**)

Applicability in this and other Programs

Module can be used for Master's Thesis or other programs.

Entrance Requirements

- Fundamental Knowledge in Mathematics and Physics
  - Basic understanding of linear algebra and geometry
  - Basic knowledge of physics
- Foundations in Electrical Engineering and Electronics
  - Understanding of electronic circuits, sensors, and basic semiconductor principles.
  - Awareness of signal acquisition and processing fundamentals.
- Basic Programming and Software Skills
  - Programming fluency in languages such as Python, C/C++
- Introductory Knowledge of Computer Vision and Machine Learning
  - Understanding of core concepts like image filtering, edge detection, and feature extraction is an advantage.
  - Basic familiarity with neural networks and Convolutional Neural Networks (CNNs).

Learning Content

- AI Applications in the Automotive Sector
- Camera and Computer Vision Basics
  - Classical Computer Vision
  - ML Approaches (CNNs)
- Computer Vision in the Automotive Sector
- In-Cabin Computer Vision
  - Requirements

- Architecture
- Hardware and Design
- Software and Algorithms

Teaching Methods

- Lectures / Instructor-Led Sessions
- Interactive Group Work
- Practical Exercises / Hands-On Labs
- Project Work
- Self-Study and Literature Research

Recommended Literature

- Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods, 4th Edition, 2017
- Deep Learning with Python, Third Edition, François Chollet and Matthew Watson, 2025.

ASE-07 Artificial Intelligence and Software Development

Type of Examination

Portfolio

ASE-08 Automotive Software Engineering

Module code	ASE-08
Module coordination	Prof. Dr. Karsten Becker
Course number and name	ASE-08 Automotive Software Engineering
Lecturers	Prof. Dr. Karsten Becker Prof. Dr. Peter Faber
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 ETCS
Language of Instruction	English

Module Objective

Students will aquire knowledge and understanding of the concepts and methods of software engineering in the automotive domain.

Specifically, students will have achieved the following learning outcomes upon completion of the module:

Subject competency

- Students know and understand the fundamental concepts and methods of software engineering
- Students are able to apply fundamentals of project management to automotive software development processes

- Students are able to derive software requirements from high-level system specifications
- Students are able to perform code reviews
- Students know how to transform an embedded software system from proof of concept to production

Methodological competency

- Students are able to define and conduct different test strategies based on requirements
- Students are able to automatically test and deploy software using CI/CD pipelines
- Students are able to work with version control
- Students are able to containerize and deploy software using Docker

Personal competency

- Students work goal-oriented and acquire a high degree of determination
- Using agile methods fosters self-motivation
- Working in a task-oriented way helps to empower a problem-solving way of thinking

Social competency

- Students are able to organize themselves in small groups to conduct a software project
- Students actively participate in team meetings fostering their ability to work in teams

Applicability in this and other Programs

-

Entrance Requirements

Knowledge of the following modules:

- Foundations of Computer Science
- Operating Systems and Networks
- Programming 1
- Programming 2
- Internet Technologies

Learning Content

- Motivation and Definition
- Software Process Models
- Methodology

    - Requirements Engineering
    - Software Architecture
    - Software Design
- Implementation
    - Coding conventions
    - Design Patterns
    - Static code analysis
    - Code metrics
- Software Test
    - Static Test
    - Dynamic Test
    - Test process
    - Test methods and strategies
- Software Quality Assurance
    - Definition
    - Reviews

Teaching Methods

- Interactive lectures and practical exercises

Remarks

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Recommended Literature

- J. Schäuffele, T. Zurawka, Automotive Software Engineering, Springer Vieweg Verlag
- H. Balzer, Lehrbuch der Software-Technik, Spektrum Akademischer Verlag
- I. Sommerville, Software Engineering, Addison Wesley Verlag
- B. Kahlbrandt, Software-Engineering mit der UML, Springer Verlag
- C Rupp et. al., UML 2 - Glasklar, Hanser Verlag
- A. Spillner, T. Linz, Basiswissen Softwaretest, dpunkt Verlag
- B. Beizer, Black - Box Testing: Techniques for Functional Testing of Software and Systems, Wiley Verlag
- P. Liggesmeyer, Software - Qualität: Testen, Analysieren und Verifizieren von Software, Spektrum Verlag
- H. Sneed, M. Winter, Testen objektorientierter Software, Hanser Verlag

ASE-08 Automotive Software Engineering

Type of Examination

written ex. 90 min.

ASE-09 Project

Module code	ASE-09
Module coordination	Prof. Dr. Andreas Grzemba
Course number and name	ASE-09 Project
Lecturer	Prof. Dr. Andreas Grzemba
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	postgraduate
Semester periods per week (SWS)	4
ECTS	6
Workload	Time of attendance: 60 hours self-study: 120 hours Total: 180 hours
Type of Examination	Portfolio
Weighting of the grade	6/90
Language of Instruction	English

Module Objective

Professional Competence

Students are able to independently or collaboratively address complex scientific and technical problems in the field of Automotive Software Engineering. They are capable of conceiving, planning, implementing, and documenting a project within the automotive software domain.

Students apply their technical knowledge in areas such as automotive software architectures, embedded systems, AUTOSAR, functional safety, and real-time systems in a practical manner. They are able to combine theoretical concepts with practical implementations and critically evaluate the results.

An example project is the planning, design, and implementation of an AUTOSAR-based software project using professional development tools (e.g., Vector DaVinci tools).

The competencies acquired prepare students specifically for project-oriented tasks in the automotive industry.

Methodological Competence

Students are able to select, apply, and reflect on appropriate methods and development processes in automotive software engineering for a given project. These include, but are not limited to:

- structured project planning and organization
- requirements analysis
- software architecture design
- implementation, integration, and testing
- documentation and presentation of results

Students learn to independently familiarize themselves with new topics, analyze relevant technical literature and documentation, and justify their methodological approach.

Personal Competence

Students further develop their ability to work independently, responsibly, and in a team-oriented manner. They are capable of coordinating tasks within a project team, collaborating constructively, and critically reflecting on results.

Through guided self-reflection, students evaluate the effectiveness of the applied methods and their own approach, with particular emphasis on time management, quality of results, and teamwork.

Applicability in this and other Programs

For this degree program: Compulsory subject

For other degree programs: None

Entrance Requirements

Formal: none
Content-related: Knowledge in software development and automotive systems is recommended.

Learning Content

- Implementation of a project topic in the field of automotive software engineering.
- The project topic does not necessarily have to be directly related to a specific module, but should have a clear connection to the development of automotive software.

- Students can propose their own project topics, but these must be approved by the supervising professor.
- Combination of practical research (e.g., software implementation, tool use, simulation) and theoretical components.
- Continuous and close technical coordination with supervisors to support project progress.

Teaching Methods

The module is designed as a project-oriented course. Students work largely independently or in small teams. Supervision is provided through regular meetings with the responsible professor and/or academic staff.

The learning process is closely aligned with real-world development workflows in the automotive industry. In addition to technical implementation, emphasis is placed on structured documentation, critical reflection, and presentation of project results.

Recommended Literature

project-specific

ASE-09 Project

Type of Examination

Portfolio

ASE-10 Compulsory optional subject 2

Module code	ASE-10
Module coordination	Dozierende des ausgewählten Moduls Instructor for the selected module
Course number and name	ASE-10 Compulsory optional subject 2
Lecturer	Dozierende des ausgewählten Moduls Instructor for the selected module
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	elective 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	Examination form of the chosen module
Weighting of the grade	5/90
Language of Instruction	English

Module Objective

This module allows students to customize their curriculum by choosing an elective out of existing university courses

The main goal is to fill knowledge gaps of the student (individuality), to acquire knowledge in current and different upcoming topics (flexibility) and the students should be able to advance in individual higher-level topics (specialization). In connection with three other electives and two language modules in the curriculum, the module offers a high degree of individuality, flexibility and specialization.

The students achieve the following learning objectives in the module:

Professional skills

The students have closed their previously identified knowledge gaps with regard to the fields of AI, mathematics for AI, data science and software development.

Methodological skills

They can apply knowledge and field-specific methods not covered by regular modules listed in this document. Also, the students collect experience in independent the work on scientific research questions.

Soft skills

The students can give constructive feedback to peers in context of peer-assessed exercises.

Since courses from other programs can be selected for the elective, the respective study and examination regulations must be consulted for module information. Further, student research projects provided by faculty staff are described by the staff once electives have to be chosen for a semester. The descriptions of university courses and projects enhance the description of this module.

Applicability in this and other Programs

not applicable

Entrance Requirements

according to chosen elective

Learning Content

In the case of a course chosen as elective, the learning content follows the course content.

The list of electives 1 contains the following modules. A detailed description can be found on iLearn and the DIT website.

- MET 2107 | Special Topics of Contactless Sensor Systems | Prof. Zabler | EN | 4 SWS | 5 ECTS
- MET 2109 | Advanced Automation Technology /Fortgeschrittene Automatisierungstechnik | Prof. Toth | EN | 4 SWS | 5 ECTS
- MMC 1004 | Case Study Cooperative and Autonomous Systems | Prof. Doric | EN | 4 SWS | 5 ECTS
- MMC 1003 | Autonomous Systems | Prof. Doric | EN | 4 SWS | 5 ECTS
- AIX-M | Basics of FPGA SoC Development | Herr Jonas Wühr | EN | 4 SWS | 5 ECTS
- AIX-B | Process Mining | Prof. Nuber | D | 4 SWS | 5 ECTS

- AIX-BM | C in automotive software development | Prof. Limbrunner | EN/D | 4 SWS | 5 ECTS
- VHB | Programming C++ part 2+3 | Prof. Faber | EN/ D |
- Additionally, the AUTOSAR course offered by Vector Informatik GmbH can be recognized as an elective.

Teaching Methods

Course-based electives involve seminar-style lessons and may contain exercises. Student research projects rely on self-learning by doing literature research, data-science analyses and the development of algorithms or models

Remarks

This course is taught at the Deggendorf Institute of Technology.

The type and duration of examination in this module depends on the chosen elective, such as a course or a student research project. This means that the examination can be a written/oral exam or an examination paper submitted by the student.

Recommended Literature

The fundamental literature of each elective is provided by study and examination regulation and the respective lecturer. However, this also includes literature research done by the student in case of student research projects.

ASE-10 Compulsory optional subject 2

Type of Examination

Examination form of the chosen module

ASE-11 Wireless and Car2X-Communication

Module code	ASE-11
Module coordination	Prof. Dr. Andreas Kassler
Course number and name	ASE-11 Wireless and Car2X-Communication
Lecturer	Prof. Dr. Andreas Kassler
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	Portfolio
Weighting of the grade	5/90
Language of Instruction	English

Module Objective

The module learning objective is to understand the fundamental concepts of wireless and vehicular networking. After successfully attending the course, students understand the following concepts and their application:
- explain the principles and limitations of wireless communication with focus on vehicular networking,
- explain important technical aspects of current wireless and vehicular networking technologies,
- explain the principles of medium access control and routing in the context of vehicular networking,
- summarise key functions and principles behind different architectures for wireless and car-2-X communication systems,
- critically evaluate different properties of a car-2-X communication systems.

Applicability in this and other Programs

This module is suitable as an FWP in any other computer science related master program and as an FWP in any bachelor computer science related program given the student has very good knowledge in computer networking.

Entrance Requirements

Students should have basic understanding of computer networks.

Learning Content

The automotive industry is increasingly relying on computer science and wireless communication. The vision of the car of tomorrow is to be fully connected with the environment. Indeed, connected cars have the capabilities to connect not only to the internet but also to other moving cars and infotainment systems. This lecture teaches important concepts from these domains, starting with wireless networks in general (from wireless signal characteristics to propagation of signals and medium access schemes), to wireless network architectures. The lecture then moves to networks of moving cars (from communication technology and system architectures, to the design of advanced traffic information systems, security and safety). Topics include

- Radio signals and propagation
- Coding, modulation, and multiplexing
- Car-2X communication pattern, use cases and requirements
- UMTS, LTE, 5G and their use for car-2X
- 802.11p and WAVE
- IEEE 1609
- ETSI ITS G5
- Broadcast, Geocast, Routing
- Beaconing and Traffic Information systems
- Simulating Car2X systems

Teaching Methods

- Interactive Lectures
- Interactive Exercise Sessions

Recommended Literature

Vehicular Networking by Christoph Sommer and Falko Dressler, published in December 2014 by Cambridge University Press.

Hannes Hartenstein and Kenneth Laberteaux (Eds.), *VANET - Vehicular Applications and Inter-Networking Technologies* , Intelligent Transport Systems, Chichester, United Kingdom, John Wiley & Sons (Wiley), 2010

ASE-11 Wireless and Car2X-Communication

Type of Examination

Portfolio

ASE-12 Automotive Microcontroller

Module code	ASE-12
Module coordination	Prof. Dr. Andreas Grzemba
Course number and name	ASE-12 Automotive Microcontroller
Lecturers	Prof. Dr. Andreas Grzemba Harald Zweck
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	Portfolio
Weighting of the grade	5/90
Language of Instruction	English

Module Objective

Technical competence

Students are able to apply the theoretical and practical content of the Automotive Microcontrollers lecture in a well-founded manner and transfer it to real automotive applications.

They are proficient in the use of professional development environments for automotive microcontrollers, in particular the Infineon AURIX microcontroller family, and can implement, test, and systematically debug software in a hardware-oriented form.

Students understand the structure, architecture, and functionality of modern automotive microcontrollers with multi-core concepts, real-time capability, high computing power,

and safety-related mechanisms. These include interrupt systems, timers, communication interfaces, and direct memory access units.

An essential component is the use of real-time operating systems and programming in the C language, taking into account automotive requirements such as determinism, reliability, and functional safety. Students are able to design automotive-compliant applications and implement them on an AURIX target system.

The learning outcomes acquired are directly transferable to activities in the automotive industry and can be applied directly in professional life.

Methodological competence

Students are able to plan and implement extensive and complex development tasks in the field of automotive embedded systems in a goal-oriented manner. They can select a technically and economically suitable implementation from various approaches and methods.

Through practical exercises and project tasks, students learn to conduct independent research, analyze technical documentation (e.g., data sheets, reference manuals), and expand their existing knowledge on their own. They apply structured approaches to software development, troubleshooting, and verification.

Personal competence

Students are aware of their responsibility as future engineers in the automotive environment, especially with regard to safety-critical systems. They are able to carry out development tasks in a cooperative and team-oriented manner and to reflect critically on them.

Applicability in this and other Programs

For this degree program: Compulsory subject

For other degree programs: None

Entrance Requirements

Formal: none
Content-related: none

Learning Content

- Planning, development, design, software development, and testing of distributed automotive embedded systems
- Design and functionality of an AURIX microcontroller
- Functional modules of an AURIX
    - Multi-core architecture, tasks, and synchronization

    - Layer architecture of operating systems such as AUTOSAR
- Interrupt architecture of the AURIX
    - Interrupt control unit
    - Interrupt vector table
    - Interrupt service routines
    - Interrupt control of hardware modules
- Design and programming of selected hardware modules under automotive constraints
    - Timer programming
    - Digital input/output programming
    - A/DC programming
    - Serial interfaces (SPI)
    - DMA programming
    - CAN bus programming

Teaching Methods

The teaching method consists of a combination of seminar-style lessons and practical laboratory exercises.

After introducing the course content and teaching the theoretical basics, practical sample tasks are worked through step by step. Students then implement smaller projects on real AURIX target systems independently. Support is provided on a group basis and adapted to each student's progress.

Students acquire programming and system skills in the field of automotive embedded systems through intensive practical work directly on the target system. Consequently, students develop a high degree of independence in dealing with complex microcontroller systems over the course of the semester.

This skill is developed through various projects of increasing difficulty, which students solve with minimal guidance. One example of this is DMA programming.

Media used include development setups with PCs, programming and debugging tools, AURIX target systems, whiteboards, scripts, exercise collections, projectors and secondary literature.

Recommended Literature

Infineon Technologies AG:
AURIX TC3xx Microcontroller Users Manual
Referenzhandbuch zur Architektur, zu Peripheriemodulen, Interrupt-Systemen, Multi-Core-Konzepten und sicherheitsrelevanten Funktionen der AURIX-Mikrocontroller.

Infineon Technologies AG:
AURIX Development Studio Getting Started Guide

Einführung in die Entwicklungsumgebung, Toolchain, Debugging und Softwareentwicklung für AURIX-Zielsysteme.

AUTOSAR Consortium:
AUTOSAR Classic Platform Specifications
Überblick über Architektur, Softwarelayer und Kommunikationsmechanismen im automobilen Umfeld

Wolf, W.:
Computers as Components Principles of Embedded Computing System Design
Morgan Kaufmann
Grundlagen moderner Embedded- und Echtzeitsysteme mit Bezug zu industriellen und automobilen Anwendungen.

Buttazzo, G. C.:
Hard Real-Time Computing Systems Predictable Scheduling Algorithms and Applications
Springer
Vertiefung der Konzepte von Echtzeitbetriebssystemen und deterministischer Softwareausführung.

ASE-12 Automotive Microcontroller

Type of Examination

Portfolio

ASE-13 Automotive Communication Architecture (inCar)

Module code	ASE-13
Module coordination	Prof. Dr. Andreas Grzemba
Course number and name	ASE-13 Automotive Communication Architecture (inCar)
Lecturer	Prof. Dr. Andreas Grzemba
Semester	3
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	5/90
Language of Instruction	English

Module Objective

Professional Competence

The overarching learning objective of this module is to enable students to understand, analyze, and apply automotive bus systems, with a particular focus on CAN bus systems and Automotive Ethernet, in academic studies and professional practice.

Students acquire in-depth knowledge of automotive in-vehicle communication systems and are able to classify them within modern vehicle electrical/electronic (E/E) architectures. They understand the principles, structures, and operating mechanisms of CAN-based and Ethernet-based communication systems and can evaluate their suitability for specific automotive applications.

In particular, students gain competencies in:

- fundamentals of digital communication systems
- architecture and operation of CAN bus systems
- principles and components of Automotive Ethernet
- comparison of classical and modern automotive network architectures
- understanding the role of bus systems in safety-critical and real-time automotive applications

Methodological Competence

Students are able to apply systematic methods for the design, analysis, and evaluation of automotive bus systems.

They learn to:

- analyze communication requirements in automotive systems
- select appropriate bus systems (CAN vs. Automotive Ethernet) based on technical constraints
- evaluate performance, scalability, determinism, and reliability of bus systems
- assess current technological developments and trends in automotive networking

The module emphasizes a structured engineering approach and supports method-based decision-making in automotive communication system design.

Personal Competence

Through the combination of theoretical instruction and practical application, students develop confidence and independence in dealing with complex automotive communication systems.

They are able to critically assess technological developments, communicate technical concepts clearly, and contribute constructively to discussions on future in-vehicle network architectures. The module strengthens their ability to take responsibility for technically sound decisions in an automotive engineering context.

Applicability in this and other Programs

For this degree program: Compulsory subject

For other degree programs: None

Entrance Requirements

Formal: none
Content-related: none

Learning Content

- Fundamentals of Digital Communication
  - OSI reference model
  - Medium access methods
  - Error detection and error handling
  - Signal oriented & service oriented communication
- Automotive Network Architectures
  - Central gateway-based architectures
  - Switched Ethernet architectures
  - Zone architecture
- CAN Bus Systems
  - Data Link Layer: CC CAN, CAN FD, CAN XL
  - Physical Layer
  - CAN characteristics, limitations, and typical automotive use cases
  - CAN System design
- Automotive Ethernet
  - Higher protocol layers in Automotive Ethernet systems
  - SOME/IP
  - IP / UDP / TCP
  - MAC
  - AVB / TSN in Automotive Ethernet / Traffic shaping mechanisms
  - Time synchronization (IEEE 1588)
  - Real-time classes in Ethernet
  - Automotive Ethernet Physical Layer
  - 10Base-T1, 100Base-T1, 1000Base-T1

Teaching Methods

Seminar-based lectures, laboratory exercises, and student presentations

The seminar-based lectures actively involve students in the learning process. Course content is documented using guided lecture notes and illustrated with practical examples. Comprehension questions, exercises, and solution examples support independent study and consolidation of knowledge.

Laboratory sessions consist of **three hands-on workshops** , focusing on:

- CAN bus systems
- Automotive Ethernet
- Security aspects in Ethernet-based vehicle networks

As part of the module, students independently prepare selected topics and present their results in the form of a **technical presentation** , fostering structured communication, argumentation skills, and professional presentation techniques.

Recommended Literature

- M. D.Natale, u.o.;
  - Understanding and Using the Controller Area Network Communication Protocol; Springer Nature; 2012
- L. K.Kim:
  - Controller Area Network Basics: Specification guide book for CAN communication beginners; 2024
- Can in Automation (CiA)
  - website: https://www.can-cia.org/can-knowledge
- W. Zimmermann, R. Schmidgall: (in German)
  - Bussysteme in der Fahrzeugtechnik, Springer Nature, 2014
- W. Lawrenz, N. Obermöller: (in German)
  - CAN Controller Area Network: Fundamentals, Design, Applications, Test Technology, VDE Verlag, 2011
- K. Matheus, T. Königseder:
  - Automotive Ethernet, Cambridge University Press
- Correa et al:
  - Automotive Ethernet, Intrepid
- IEEE:
  - AVB / TSN IEEE 802.3 Standard Family

ASE-13 Automotive Communication Architecture (inCar)

Type of Examination

Portfolio

ASE-14 Master Modul

Module code	ASE-14
Module coordination	Prof. Dr. Andreas Grzemba
Course number and name	ASE-14 Master's thesis ASE-14 Master's colloquium
Lecturers	Prof. Dr. Andreas Grzemba Betreuer der Abschlussarbeit Supervisor of thesis
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	postgraduate
Semester periods per week (SWS)	2
ECTS	25
Workload	Time of attendance: 30 hours self-study: 720 hours Total: 750 hours
Type of Examination	colloquium, master thesis
Weighting of the grade	25/90
Language of Instruction	English

Module Objective

Professional Competence

Students are able to independently work on and solve a complex problem in the field of Automotive Software Engineering based on scientific principles. They demonstrate the ability to analyze a research-oriented problem, develop suitable solutions, and document the results in a structured and comprehensible manner.

The Masters thesis focuses on the creative development and evaluation of new methods, concepts, or system solutions, taking into account a holistic system perspective. Students apply advanced knowledge from areas such as automotive software architectures, embedded systems, real-time systems, AUTOSAR, and functional safety.

As part of the module, students are able to present and defend their work in a scientific colloquium, clearly explaining objectives, methodology, and results, and responding competently to technical questions.

Methodological Competence

Students are able to select, apply, and justify appropriate scientific methods for addressing a complex research or development task in Automotive Software Engineering. They independently plan and structure their work, define objectives, and follow a systematic approach.

This includes:

- analysis and evaluation of scientific literature and technical standards
- design of suitable concepts, architectures, or experimental setups
- implementation and/or experimental validation
- evaluation and interpretation of results

Within the colloquium, students demonstrate the ability to critically reflect on their methodology, discuss alternative approaches, and justify design decisions.

Personal Competence

Students demonstrate a high degree of independence, responsibility, and perseverance in completing a long-term academic task. They are capable of managing their time effectively, working autonomously, and maintaining regular communication with supervisors.

During the colloquium, students show professional communication skills, confidence in presenting complex technical content, and the ability to engage in constructive academic discussion.

Applicability in this and other Programs

For this degree program: Compulsory subject

For other degree programs: None

Entrance Requirements

Formal: none
Content-related: Successful completion of advanced modules in Automotive Software Engineering is recommended.

Learning Content

- The topic of the Masters thesis is defined, supervised, and academically supported by a professor of the participating universities
- The Masters thesis includes:

    - presentation of the state of the art in science and technology related to the topic
    - description of the methodology and workflow of the theoretical and/or experimental work
    - integration of the students work into the research activities of the supervising institute/faculty and, where applicable, industrial partners
    - documentation of own publications, if applicable
    - presentation and critical evaluation of the achieved technical and scientific results
- Mandatory colloquium:
    - oral presentation of the Masters thesis
    - defense and discussion of objectives, methods, and results
    - evaluation of the students ability to argue scientifically and respond to questions

Teaching Methods

The Masters thesis is carried out as an **independent scientific project** . Students work autonomously over an extended period of time, supported by regular consultations with their academic supervisor.

Preparation for the colloquium includes structured presentation of results and reflective discussion with the supervisor.

Recommended Literature

topic-specific

ASE-14 Master's thesis

Type of Examination

master thesis

ASE-14 Master's colloquium

Type of Examination

colloquium