Aalen University of Applied Sciences

Module handbook

SoSe 26

Master Electrical Engineering (MRE)
SPO-32

March 9, 2026

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Projekt 1

Module Number	49001
Module Manager	Dean of studies
E-Mail	e.sekretariat@hs-aalen.de
Credits	5
Workload Class	30
Workload Self-Study	120
Offered	Winter term, Summer term
Modul Type	Mandatory Module
Language	English
Use in other SG	
Module Duration	1 Semester

Participation Requirements: none

Module Objectives

Course Content: The professors of the degree programme (supervisors) issue self-contained problems from the field of electrical engineering. They can also come from the context of a larger overall project, e.g. in the context of co-operation with a partner from in- dustry. One of these problems must be chosen by the students. The problem must be analysed and a solution developed and implemented. The problem and solution must be documented. The student will receive technical and methodological support from the supervisor. The student reports regularly to the supervisor on the progress of the work.

External work is not planned, as at this stage of learning, basic skills in the development and presentation of a more complex topic must first be acquired in close coordination with the lecturers of the degree programme. At the start of the project, students agree with their supervisor which topics from the Studium Generale are still missing from their individual educational biography and are a substantially important part of the project. For example, in the case of a lack of academic writing, this is agreed to be attended. Civil society effects of developments in the field of engineering and ethical aspects should also be considered. These topics can also be attended as part of the university's Studium Generale. The respective contents can be found in the university's Studium Generale program. In order for the corresponding hours to be credited, a summary sheet of the workload achieved and a written report on the courses completed must be submitted. Alternatively, voluntary or civic engagement during the course of study can be performed, documented and credited. The time required for the Studium Generale in Project 1 is 30 working hours (1 credit point corresponds to a workload of 30 working hours).

Professional Competence: Students are able to carry out a challenging electrical engineering project in an engineering and team-orientated manner. They systematically develop a suitable solution to a problem. They realise, document, evaluate and defend this solution. To do this, they research relevant specialist literature. Students plan the individual project phases independently and proceed methodically to find a solution. Students are able to present complex interdisciplinary subjects and can assess their relationships. They are able to deal autonomously with socio-political questions.

Interdisciplinary Competence: Students strengthen their time management, conflict management and presentation skills by working on projects. Students are able to use the skills they have acquired in a targeted manner. Students also recognize the importance for their personal development and for society.

Literature: none

Type:

- Project work

Module Examination

Requirements for Admission to the Module Exam: none

Final grade: The grade for the Project 1 module is based on the grading of the project and is only deemed to have been passed if the ungraded Studium Generale is also completed as a composite sheet and written report.

Auxiliary means: none

Included Courses

CP	SWS	Semester	Type	Type and Duration of Proof of Performance
49101: Projekt 1				
5	2	1	P	PLP graded

Comments

none

Predictive Analytics

49002

Module Number	49002
Module Manager	Prof. Dr. Heckmann
E-Mail	martin.heckmann@hs-aalen.de
Credits	5
Workload Class	60
Workload Self-Study	90
Offered	Winter term
Modul Type	Mandatory Module
Language	English
Use in other SG	
Module Duration	1 Semester

Participation Requirements: none

Module Objectives

Course Content:

- Basic concepts: Machine learning, exploratory data analysis, preparation of data sets, validation models
- Supervised learning, unsupervised learning, reinforcement learning
- Regression, classification
- Functions of several variables
- Partial derivatives
- Gradient
- Gradient descent
- Optimization with constraints
- Regularization
- Ridge regression
- Lasso
- Maximum Likelihood Estimation
- Logistic regression, decision trees, . . .
- Ensemble methods

- Bagging
- Random Forest
- Boosting
- Evaluation of classifiers
- Error rate
- Confusion matrix
- Precision, Recall, Sensitivity, Specificity
- Receiver Operating Curve (ROC)

Professional Competence: General:
Students are able to develop and apply data-driven prediction models.
Students can effectively plan statistical experiments, carry out data collection and process data. They are able to select and apply the correct methods for a specific problem. They are able to critically examine and evaluate the results of the analysis.

Interdisciplinary Competence: Smaller problems are dealt with both independently and in teams.

Literature:

1. James, Witten, Hastie, Tibshirani: An Introduction to Statistical Learning with Applications in Python, 1st Edition. Springer (2023)
2. Géron: Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow: Concepts, tools, and techniques to build intelligent systems, 3rd Edition. O'Reilly Media (2022).
3. Bishop: Pattern Recognition and Machine Learning. Springer (2006)
4. Ng: Machine Learning Yearning. deeplearning.ai (2018).
5. Murphy: Machine Learning: A Probabilistic Perspective. MIT Press (2012)

Type:

- Lecture
- Excercise
- Selbststudium

Module Examination

Requirements for Admission to the Module Exam: none

Final grade: PLK 90, 100%

Auxiliary means: Lecture notes, lecture slides, scientific calculator (non graphing, not programmable), printouts, books

Included Courses

CP	SWS	Semester	Type	Type and Duration of Proof of Performance
49102: Predictive Analytics *Prof. Dr. Martin Heckmann*				
5	4	1/2	VÜ	PLK 90

Comments

Import MLD-31: 56202

Physical Computing

49003

Module Number	49003
Module Manager	Prof. Dr. Markus Weinberger
E-Mail	markus.weinberger@hs-aalen.de
Credits	5
Workload Class	60
Workload Self-Study	90
Offered	Winter term
Modul Type	Mandatory Module
Language	English
Use in other SG	
Module Duration	1 Semester

Participation Requirements: none

Module Objectives

Course Content: Typical structure of IoT server backends, function and common technologies of the individual components. Connection, administration, and management of networked devices in the backend, storage and processing of data, display and output of results on dashboards or apps, authentication, user management, and security. The content is largely developed in practical exercises using the example of a commercially available system on the market.

Professional Competence: Learning Outcomes:

The typical components of IoT server backends can be assigned to common market offerings and evaluated in terms of their functionality. Based on specified, exemplary applications, users can independently design and implement their own applications.

Interdisciplinary Competence: On the basis of their specialised domain (electrical engineering, mechatronics or computer science), students are able to develop further technical fundamentals from related domains largely independently and use them to solve problems.

The students can work together in small groups and teams.

Literature: Slama, Dirk, et al. Enterprise IoT: Strategies and Best Practices for Connected Products and Services. " O'Reilly Media, Inc.", 2015.

Type:

- Lecture

- Excercise
- Project work
- Laboratory

Module Examination

Requirements for Admission to the Module Exam: none

Final grade: PLP, benotet.

Auxiliary means:

Included Courses

CP	SWS	Semester	Type	Type and Duration of Proof of Performance
49103: Physical Computing *Prof. Dr. Markus Weinberger*				
5	4	1 oder 2	Lecture, Lab	Examination: PLM, based on projects developed during the course.

Comments

Signal Processing and Modern Wireless Communications

Module Number	49004
Module Manager	Prof. Dr. Ludwig
E-Mail	stephan.ludwig@hs-aalen.de
Credits	5
Workload Class	60
Workload Self-Study	90
Offered	Winter term
Modul Type	Mandatory Module
Language	English
Use in other SG	
Module Duration	1 Semester

Participation Requirements: none

Module Objectives

Course Content:

- Digital non-linear modulation schemes (FSK, CPM) in communication systems
- Synchronization and channel estimation in communication systems for OFDM and PAM
- Modern forward error correction coding and decision schemes (LDPC-, Turbo-, Polar-Codes, Channel Equalization) , Network Coding/Fountain Codes
- Data compression using forward error correction schemes, Physical Layer security
- Array signal processing in RADAR systems
- Joint Communication and Sensing
- 6G cellular radio, WiFi 7+, Bluetooth Low Energy, DECT NR+

Professional Competence: Students can identify and describe advanced concepts and algorithms in digital signal processing as they are used in the physical layer of modern wireless communication systems. They can apply its essential methods and tools. Students are able to correctly interpret and criticize results from digital signal processing algorithms and in wireless communication systems. They show that they can solve particular tasks from such digital signal processing on their own and in teams. In such, they show that they are able to and put their gained knowledge into practice.

Interdisciplinary Competence: Based on the integrated group exercises and numerical programming tasks, students have amplified their ability in communication and to work in teams. They can apply their abilities self-directed as well as in teams, when solving specific tasks.

Literature:

- Proakis, Salehi, Bauch: Contemporary Communication Systems Using MATLAB, 3rd, Cengage Learning, 2013
- Richards: Fundamentals of Radar Signal Processing, 3rd, McGraw Hill, 2022
- Mahafza: Radar Systems Analysis and Design Using MATLAB, 4th, Chapman and Hall/CRC, 2022
- Johnson: Iterative Error Correction, Cambridge University Press, 2009
- Scientific Papers provided in the lecture

Type:

- Lecture
- Excercise

Module Examination

Requirements for Admission to the Module Exam: Until midterm: Students have to select a scientific paper from a list according to the lecture topics. They work the core idea of the paper, scientifically discussion/criticize its idea, its way of presentation and its results; finally they present all their results in 10 minutes + 5 minutes Q&A/discussion. Insufficiency will exclude the student from the exam.

Final grade: Oral Exam (duration: 30 minutes)

Auxiliary means: none

Included Courses

CP	SWS	Semester	Type	Type and Duration of Proof of Performance
49104: Signal Processing and Modern Wireless Communications *Prof. Dr. Stephan Ludwig*				
5	4	1 oder 2	V, Ü	PLM 30 min graded

Comments

Wahlpflicht 1

49005

Module Number	49005
Module Manager	Dean of studies
E-Mail	e.sekretariat@hs-aalen.de
Credits	5
Workload Class	depending on the module chosen
Workload Self-Study	150
Offered	Winter term, Summer term
Modul Type	Elective Module
Language	Depending on the module chosen
Use in other SG	
Module Duration	1 Semester

Participation Requirements: Depending on the module chosen

Module Objectives

Course Content: Depending on the module chosen

Professional Competence: Depending on the module chosen

Interdisciplinary Competence:

Literature: Depending on the module chosen

Type:

- Depending on the module chosen

Module Examination

Requirements for Admission to the Module Exam: Depending on the module chosen

Final grade: Depending on the module chosen

Auxiliary means: Depending on the module chosen

Included Courses

CP	SWS	Semester	Type	Type and Duration of Proof of Performance
49105: Wahlpflicht 1 *Depending on the module chosen*				
5		1	Depending on the module chosen	Depending on the module chosen

Comments

Depending on the module chosen

Wahlpflicht 2

49006

Module Number	49006
Module Manager	Dean of studies
E-Mail	e.sekretariat@hs-aalen.de
Credits	5
Workload Class	depending on the module chosen
Workload Self-Study	150
Offered	Winter term, Summer term
Modul Type	Elective Module
Language	Depending on the module chosen
Use in other SG	
Module Duration	1 Semester

Participation Requirements: Depending on the module chosen

Module Objectives

Course Content: Depending on the module chosen

Professional Competence: Depending on the module chosen

Interdisciplinary Competence:

Literature: Depending on the module chosen

Type:

- Depending on the module chosen

Module Examination

Requirements for Admission to the Module Exam: Depending on the module chosen

Final grade: Depending on the module chosen

Auxiliary means: Depending on the module chosen

Included Courses

CP	SWS	Semester	Type	Type and Duration of Proof of Performance
49106: Wahlpflicht 2 *Depending on the module chosen*				
5		1 or 2	Depending on the module chosen	Depending on the module chosen

Comments

Depending on the module chosen

Projekt 2

Module Number	49007
Module Manager	Dean of studies
E-Mail	e.sekretariat@hs-aalen.de
Credits	5
Workload Class	30
Workload Self-Study	120
Offered	Winter term, Summer term
Modul Type	Mandatory Module
Language	English
Use in other SG	
Module Duration	1 Semester

Participation Requirements: none

Module Objectives

Course Content: The professors of the degree programme (supervisors) issue self-contained problems from the field of electrical engineering. They can also come from the context of a larger overall project, e.g. in the context of co-operation with a partner from industry. One of these problems must be chosen by the students. The problem must be analysed and a solution developed and implemented. The problem and solution must be documented. The student will receive technical and methodological support from the supervisor. The student reports regularly to the supervisor on the progress of the work. External work is not planned, as at this stage of learning, basic skills in the development and presentation of a more complex topic must first be acquired in close coordination with the lecturers of the degree programme.

Professional Competence: Students are able to carry out a challenging electrical engineering project in an engineering and team-orientated manner.

They systematically develop a suitable solution to a problem. They realise, document, evaluate and defend this solution.

To do this, they research relevant specialist literature.

Students plan the individual project phases independently and proceed methodically to find a solution.

Interdisciplinary Competence: Students strengthen their time management, conflict management and presentation skills by working on projects. Students are able to use the skills they have acquired in a targeted manner.

Literature: none

Type:

- Project work

Module Examination

Requirements for Admission to the Module Exam: none

Final grade:

Auxiliary means: none

Included Courses

CP	SWS	Semester	Type	Type and Duration of Proof of Performance
49207: Projekt 2				
5	2	2	P	PLP graded

Comments

none

Machine Learning & Deep Learning

49008

Module Number	49008
Module Manager	Prof. Dr. Tim Dahmen
E-Mail	tim.dahmen@hs-aalen.de
Credits	5
Workload Class	60
Workload Self-Study	90
Offered	Summer term
Modul Type	Mandatory Module
Language	English
Use in other SG	Can be selected from other master's programs. Limited number of participants.
Module Duration	1 Semester

Participation Requirements: none

Module Objectives

Course Content:

- Basics: Machine Learning (ML), Exploratory Data Analysis, Data Reparation, Validation, Generalization
- Artificial Neutral Networks
- Deep Learning
- Introduction to Artificial Neural Networks
- Basic Building Blocks
- Learning in Neural Networks
- Examples and Architectures
- Deep Learning
- The General Idea of Deep Learning
- Convolutional Neural Networks
- Architectures
- Transfer Learning
- Autoencoders

Professional Competence: Students are able to use machine learning methods to develop applications for classification and regression models and use them within their area of expertise.

Students can apply various machine learning methods. They are able to select and apply the correct methods for a specific problem. They are able to critically examine and evaluate the results of the application. They are able to implement examples and tasks using the scikitlearn, tensorflow, keras or pytorch libraries.

Interdisciplinary Competence: Students can work on smaller problems both independently and in teams. They present their work in presentations and can justify their choice of methods.

Literature:

1. Rebala, G. et al.: An Introduction to Machine Learning. Springer
2. Duda et al.: Pattern Classification. Wiley-Interscience.
3. Abu-Mostafa: Learning from Data - A short course. Bilingual Books.
4. Joshi, Ameet V, Machine Learning and Artificial Intelligence. Springer
5. Singh, Pramood et al.: Learn TensorFlow2.0 – Implement Machine Learning and Deep Learning. Springer

Type:

- Lecture
- Excercise
- Selbststudium

Module Examination

Requirements for Admission to the Module Exam: none

Final grade: PLK, 100%

Auxiliary means: none

Included Courses

CP	SWS	Semester	Type	Type and Duration of Proof of Performance
49208: Machine Learning and Deep Learning *Prof. Dr. Tim Dahmen*				
5	4	1/2	VÜ	PLK 120

Comments

Programming Internet of Things

Module Number	49009
Module Manager	Prof. Dr. Bantel
E-Mail	winfried.bantel@hs-aalen.de
Credits	5
Workload Class	60
Workload Self-Study	90
Offered	Summer term
Modul Type	Mandatory Module
Language	English
Use in other SG	
Module Duration	1 Semester

Participation Requirements: None

Module Objectives

Course Content:

- Programming technical systems
- Hardware interfaces
- Network protocols such as HTTP and MQTT
- Cloud computing
- Real-time problems and time rollover
- Energy-saving options

Professional Competence: Students can transfer the technologies of the Internet to the Internet of Things and introduce energy-saving measures. They can independently model and implement complex systems with both machine-to-machine and human-to-machine communication and integrate new components into existing systems. Students can develop software for technical systems ("embedded programming"). They can analyze technically networked systems for exchanging data via various protocols such as HTTP or MQTT. They are able to develop these system components (everyday products), also taking real-time aspects into account.

Interdisciplinary Competence: The project enables students to present and discuss their developments as a team. In particular, by networking the definition and discussion of interfaces, students are able to discuss and define these together.

Literature: No dedicated technical literature, set of slides

Type:

- Project work

Module Examination

Requirements for Admission to the Module Exam: None

Final grade: Project graded

Auxiliary means: all

Included Courses

CP	SWS	Semester	Type	Type and Duration of Proof of Performance
49209: Programming Internet of Things *LB Linus Hoppe*				
5	4	1/2	P	PLP graded

Comments

Import MIN-30: 28122

Modern Methods of Networks

49010

Module Number	49010
Module Manager	Prof. Dr. Liebschner
E-Mail	marcus.liebschner@hs-aalen.de
Credits	5
Workload Class	60
Workload Self-Study	90
Offered	Summer term
Modul Type	Mandatory Module
Language	English
Use in other SG	
Module Duration	1 Semester

Participation Requirements: none

Module Objectives

Course Content:

1. Introduction to networks

2. Computer networks

- Basics of information science
- Basic of computer networks
- Protocols and protocol layers
- Modeling (TCP/IP, hybrid, ISO)
- Network technologies
- Transmission medium
- Data encoding
- Adressing
- Frame formats
- IPv4, IPv6
- DNS, DHCP, HTTP
- Network virtualization (VPN, VLAN)

3. Sensor networks

- Internet of Things (UART, SPI, I2C)
- Industry 4.0 (CAN, Modbus)
- Wireless networks (433 MHz, 868 MHz, 2.4 GHz)

4. Practical project: Development of a sensor network
   - Connection of sensors and communication of sensor data in small groups (4-6 students)
   - Establishment of a interconnected sensor network through cooperation between all small groups
   - Creation of a connected system with database and data visualization
5. Satellite communication
6. Electrical networks
   - Structure and characteristics of electrical power grids
   - Equipment for power grids

Professional Competence: Students are able to reproduce the content on computer, sensor and electrical networks. Students are also able to design, configure and evaluate computer and sensor networks. Students will be able to describe the technological concepts for technical implementation. In addition, students will be able to apply protocols and procedures for the secure data transmission.

Interdisciplinary Competence: Through the practical project, students are able to work together in small and big groups and find solutions together.

Literature: Tanenbaum/Wetherall: Computer Networks. Pearson.

Type:

- Lecture
- Excercise

Module Examination

Requirements for Admission to the Module Exam: none

Final grade: exam grade

Auxiliary means: none

Included Courses

CP	SWS	Semester	Type	Type and Duration of Proof of Performance
49210: Modern Methods of Networks *Dr. Moritz Benninger*				
5	4	1 or 2	V, Ü	PLK 90 graded

Comments

Smart Systems Engineering and Advanced Techniques

49011

Module Number	49011
Module Manager	Prof. Dr. Csiszár
E-Mail	orsolya.csiszar@hs-aalen.de
Credits	5
Workload Class	60
Workload Self-Study	90
Offered	Summer term
Modul Type	Mandatory Module
Language	English
Use in other SG	
Module Duration	1 Semester

Participation Requirements: none

Module Objectives

Course Content: This course explores advanced concepts and methods in intelligent systems, focusing on mathematical foundations and cutting-edge applications. Topics include:

- Stochastic processes
- Probability and filter theory
- Smart sensors and sensor data fusion
- Regression, clustering and mixture models
- Advanced signal processing (noise, correlations, wavelets, pattern recognition)
- Fuzzy Logic and Fuzzy Sets
- Application of Fuzzy Logic
- Predictive Maintenance (ML/AI based)
- Recent Advances in Intelligent Systems.

Professional Competence: Students are able to explain the core mathematical principles behind smart systems. By the mean of dedicated code snippets, programmed in Python and leveraging tailored scientific, numerical and visualization package's the students are able to simulate, explore and visualize the behavior of smart system before their deployment. With their foundational knowledge in other related areas, such as advanced signal processing and stochastic modelling under uncertainties, they are able to approach advanced problems in smart system design.

Interdisciplinary Competence: Students enhanced their ability to collaborate in teams. They improved their critical thinking skills regarding the use of smart algorithms in real-world applications concerning ethic aspects and transparency.

Literature: Relevant articles and a course script will be provided during class.

Type:

- Lecture
- Excercise

Module Examination

Requirements for Admission to the Module Exam: none

Final grade: exam grade

Auxiliary means: none

Included Courses

CP	SWS	Semester	Type	Type and Duration of Proof of Performance
49211: Smart Systems Engineering and Advanced Techniques *Prof. Dr. Michael Ćurčić*				
5	4	1 or 2	V, Ü	PLK 90

Comments

Wahlpflicht 3

49012

Module Number	49012
Module Manager	Dean of studies
E-Mail	e.sekretariat@hs-aalen.de
Credits	5
Workload Class	depending on the module chosen
Workload Self-Study	150
Offered	Winter term, Summer term
Modul Type	Elective Module
Language	Depending on the module chosen
Use in other SG	
Module Duration	1 Semester

Participation Requirements: Depending on the module chosen

Module Objectives

Course Content: Depending on the module chosen

Professional Competence: Depending on the module chosen

Interdisciplinary Competence:

Literature: Depending on the module chosen

Type:

- Depending on the module chosen

Module Examination

Requirements for Admission to the Module Exam: Depending on the module chosen

Final grade: Depending on the module chosen

Auxiliary means: Depending on the module chosen

Included Courses

CP	SWS	Semester	Type	Type and Duration of Proof of Performance
49212: Wahlpflicht 3 *Depending on the module chosen*				
5		2	Depending on the module chosen	Depending on the module chosen

Comments

Depending on the module chosen

Master Thesis

9999

Module Number	9999
Module Manager	Dean of studies
E-Mail	e.sekretariat@hs-aalen.de
Credits	30
Workload Class	
Workload Self-Study	900
Offered	Winter term, Summer term
Modul Type	Mandatory Module
Language	English
Use in other SG	
Module Duration	1 Semester

Participation Requirements: At least 50 CP from the courses of the Master's degree programme

Module Objectives

Course Content: Depends on the chosen topic.

Professional Competence: Students are able to apply and combine the knowledge they have learnt and supplement it with independent research by independently solving a complex task and presenting and defending their solution in a colloquium.

Interdisciplinary Competence: Students can obtain information that goes beyond the content of the degree programme and is relevant to their task and can integrate this into their existing knowledge. They can categorise their work in the context of the respective field and differentiate it from comparable work and approaches.

Literature:

Type:

- Project work
- Selbststudium

Module Examination

Requirements for Admission to the Module Exam:

Final grade: A written thesis must be created. This must be presented and defended in a colloquium.

Auxiliary means:

Included Courses

CP	SWS	Semester	Type	Type and Duration of Proof of Performance
9999: Master Thesis *Professors of the faculty*				
30		3		PLS

Comments