Course Handbook Applied Informatics Master

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Head of Studies	Prof. Dr. Markus Esch
Deputy Head of Studies	Prof. Dr. Peter Birkner
Chairman of Examination	Prof. Dr. Klaus Berberich
Deputy Chairman of Examination	Prof. Dr.-Ing. Martin Burger

Qualifikation Goals of Study Programme

Applied Informatics Master - mandatory courses (overview)

Module name (EN)	Code	SAP-P	Semester	Hours per semester week / Teaching method	ECTS	Module coordinator
Business Computing	PIM-BUC	P221-0049	2	2V+2U	6	Prof. Dr.-Ing. André Miede
Business Management & Consulting	PIM-BMA	P221-0050	1	2V+1U+1S	6	Prof. Dr.-Ing. André Miede
Computability and Complexity Theory	PIM-BK	P221-0048	1	4V	6	Prof. Dr. Maximilian Altmeyer
Data Engineering	PIM-DE	P222-0050	2	3V+1U	6	Prof. Dr. Klaus Berberich
Data Science	PIM-DS	P221-0051	1	3V+1U	6	Prof. Dr. Klaus Berberich
Discrete Mathematics	PIM-DM	P222-0051	1	3V+1U	6	Prof. Dr. Peter Birkner
Master Thesis	PIM-MT	T221-0054	4	-	30	Studienleitung
Project work	PIM-PA	P221-0056	2	2PA	6	Professor/innen des Studiengangs
Software Architecture	PIM-SAR	P221-0059	1	2PA+2S	6	Prof. Dr. Markus Esch

(9 modules)

Applied Informatics Master - optional courses (overview)

Module name (EN)	Code	SAP-P	Semester	Hours per semester week / Teaching method	ECTS	Module coordinator
"Engineering Visions" and Intercultural Experience Intensive Program	PIM-EVIE	P221-0134, P610-0455	2	3PA+1S	4	Prof. Dr. Martin Löffler-Mang
Advanced Presentation and Writing Skills for ICT Studies	PIM-APWS	P222-0086	2	2V	3	Dipl.-Übers. Betina Lang
Advanced Topics in Data Science & Engineering	PIM-ATDE	P221-0151	1	2V	3	Prof. Dr. Klaus Berberich
Astronomy Seminar	PIM-ASTR	P231-0114	1	1V+1PA	2	Prof. Dr. Martin Löffler-Mang
Automotive Engineering	PIM-ATEC	P200-0029	1	2V+2P	6	Prof. Dr. Horst Wieker
Bioinformatics	PIM-BIOI	P221-0152	2	4V	6	Prof. Dr. Gerald Kroisandt
Building Systems Technology	PIM-GSYS		1	4V	6	Prof. Dr. Michael Igel
Content Management Systems	PIM-CMS	P221-0137	1	2V+2PA	6	Dipl.-Inform. Roman Jansen-Winkeln
Cryptography Engineering	PIM-CE	P221-0154	2	2V+2P	6	Prof. Dr. Damian Weber
Cryptography Project	PIM-PKRY	P222-0095	1	4PA	6	Prof. Dr. Damian Weber
Deep Learning	PIM-DL	P221-0155	3	2V+2P	6	Prof. Dr. Klaus Berberich

Module name (EN)	Code	SAP-P	Semester	Hours per semester week / Teaching method	ECTS	Module coordinator
Distributed Algorithms and Applications	PIM-VAA	P222-0072	1	2P+2S	6	Prof. Dr. Markus Esch
Embedded Systems	PIM-EMBS	P200-0037	1	2V+2P	6	Prof. Dr. Martina Lehser
Empirical Evaluation of Interactive Systems	PIM-EEIS	P221-0205	2	2V+2U	6	Prof. Dr. Maximilian Altmeyer
Environmental Decision Support Systems	PIM-EDSS	P222-0106	2	4V	6	Prof. Steven Frysinger
Future Internet: Experimental Networks and Software Defined Networking	PIM-FSDN		1	4V	5	Prof. Dr. Damian Weber
GPU Computing	PIM-GPU	P222-0091	1	2V+2P	5	Prof. Dr. Jörg Keller
Human Factors	PIM-HUMF	P221-0113	2	4V	6	Prof. Steven Frysinger
Industrial Robotics	PIM-IR	P221-0199	1	2V+2P	5	Prof. Dr. Michael Kleer
Industrial UX Engineering	PIM-IUE	P221-0207	3	2V+2U	6	Prof. Dr.-Ing. Pascal Stoffels
IT & Production	PIM-IUP	P221-0206	2	2V+2U	6	Prof. Dr.-Ing. Pascal Stoffels
IT and TC Law	PIM-ITR	P222-0056	2	2V	3	Studienleitung
Modeling Languages and Communication Systems	PIM-MOD	P222-0060	1	2V+2U	6	Prof. Dr. Reinhard Brocks
Planning and Running IT	PIM-PDIW	P221-0200	1	1V+1P	3	Prof. Dr.-Ing. André Miede

Module name (EN)	Code	SAP-P	Semester	Hours per semester week / Teaching method	ECTS	Module coordinator
Workshops						
Planning and Running RoboNight Workshops	PIM-PDRW	P222-0092	2	1PA+1S	3	Prof. Dr. Steffen Knapp
Planning and Running Technical Workshops	PIM-PDTW	P221-0187	2	1V+1P	3	Prof. Dr.-Ing. André Miede
Quantum Computing	PIM-QC	P221-0216	1	2V+2P	5	Dipl.-Physiker Michael Meßner
Research and Innovation Management	PIM-FUIM	P200-0035	2	4SU	6	Prof. Dr.-Ing. John Heppe
Service Management with ITIL	PIM-ITIL	P222-0081	2	2V	3	Prof. Dr.-Ing. André Miede
Shape Analysis	PIM-SHAN		2	2V+2P	6	Dr.-Ing. Jörg Herter
Simulation and Hardware Implementation of Digital Algorithms and Systems	PIM-DALG	P222-0109	1	2V+2P	5	Prof. Dr. Martin Buchholz
Sino-German Smart Sensor Project	PIM-SGSP		1	4PA	6	Prof. Dr. Martina Lehser
Software Development for Communication Systems	PIM-SWKS	P221-0191, P222-0070	2	2V+2P	6	Prof. Dr. Reinhard Brocks
Software Quality Engineering	PIM-SQE	P221-0144	1	2V+2PA	6	Prof. Dr.-Ing. Martin Burger
Strategic Communication	PIM-SKTA	P221-0160	-	4S	6	Prof. Dr. Steffen Knapp

Module name (EN)	Code	SAP-P	Semester	Hours per semester week / Teaching method	ECTS	Module coordinator
for Technology Selection Seminar						
Traffic Control and Traffic Management	PIM-VSVM	P222-0097	2	4V	6	Prof. Dr. Horst Wieker
Virtual Machines and Program Analysis	PIM-VMPA	P221-0148	1	2V+4P	8	Dr.-Ing. Jörg Herter
Web Applications	PIM-WEBA	P221-0150, P610-0523	2	2V+2U	6	Prof. Dr. Thomas Kretschmer
Web Development	PIM-WEB	P221-0209	3	2V+2U	6	Prof. Dr. Maximilian Altmeyer

(39 modules)

Applied Informatics Master - mandatory courses

Business Computing

Module name (EN): Business Computing
Degree programme: Applied Informatics, Master, SO 01.10.2026
Module code: PIM-BUC
Hours per semester week / Teaching method: 2V+2U (4 hours per week)
ECTS credits: 6
Semester: 2
Mandatory course: yes
Language of instruction: German

Assessment:
Oral examination 80%, presentation 20%

[*updated 26.02.2018*]

Applicability / Curricular relevance:

DFI-BUC Computer Science, Master, ASPO 01.10.2018 , semester 2, optional course
KIM-BUC Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 2, optional course, informatics specific
PIM-BUC (P221-0049) Applied Informatics, Master, ASPO 01.10.2017 , semester 2, mandatory course
PIM-BUC (P221-0049) Applied Informatics, Master, SO 01.10.2026 , semester 2, mandatory course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
PIM-BMA Business Management & Consulting

[*updated 16.12.2025*]

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. André Miede

Lecturer: Prof. Dr.-Ing. André Miede

[*updated 16.10.2016*]

Learning outcomes:
After successfully completing this module, students will be able to list and describe the interrelationships between a company´s organizational processes and their IT implementation. They will be able to explain the importance of coordinating and aligning both areas for the development of effective IT solutions. Lastly, students will be able to apply basic methods and tools for modelling business processes in theory and practice.

[*updated 26.02.2018*]

Module content:
I. Theoretical Part (also includes exercises):

1. Introduction and overview
   Processes, process management, business processes, workflows etc.
2. Process modeling
   Layers, phases, views and methods (EPC, BPMN, UML etc.)
3. Process management with standard business management software
   Enterprise Resource Planning (ERP), Supply Chain Management (SCM), Customer Relationship Management (CRM), Data Warehouse (DWH) etc.
4. Business process modeling and simulation with ARIS
   (see practical part)
5. Related IT topics

Workflow management systems (WFMS), service-oriented architecture (SOA), cloud computing

II. Practical Part: Process design and analysis with ARIS (ARIS -- Architektur integrierter Informationssysteme)

o ARIS is a widely used tool for process management, especially the modelling and simulation of business processes. As part of the course, students will work on exercises live with ARIS (Architect, Simulator, Publisher).

o The software will be available to students free of charge on their private computers.

o The Software AG has agreed to certify the successful completion of all ARIS tasks.

[*updated 26.02.2018*]

Recommended or required reading:
Andreas Gadatsch: Grundkurs Geschäftsprozess-Management, Methoden Und Werkzeuge für die IT-Praxis: Eine Einführung für Studenten und Praktiker. Springer Vieweg.

Marlon Dumas; Marcello La Rosa; Jan Mendling; Hajo Reijers: Fundamentals of Business Process Management. Springer.

Jakob Freund; Bernd Rücker: Praxishandbuch BPMN 2.0. Hanser.

Heinrich Seildmeier: Prozessmodellierung mit ARIS® -- Eine beispielorientierte Einführung für Studium und Praxis. Springer.

ARIS Community: http://www.ariscommunity.com/university/students

Tim Weilkiens; Christian Weiss; Andrea Grass: Basiswissen Geschäftsprozessmanagement, Aus- und Weiterbildung zum OMG Certified Expert in Business Process Management (OCEB) -- Fundamental Level. dpunkt.verlag.

Inge Hanschke; Gunnar Giesinger; Daniel Goetze: Business Analyse -- Einfach und effektiv, Geschäftsanforderungen verstehen und in IT-Lösungen umsetzen. Hanser.

[*updated 26.02.2018*]

Business Management & Consulting

Module name (EN): Business Management & Consulting

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-BMA

Hours per semester week / Teaching method:
2V+1U+1S (4 hours per week)

ECTS credits:
6

Semester: 1

Mandatory course: yes

Language of instruction:
German

Assessment:
Oral examination 70%, presentation 30%

[*updated 26.02.2018*]

Applicability / Curricular relevance:

DFI-BMA (P610-0270) Computer Science, Master, ASPO 01.10.2018 , semester 1, optional course
PIM-BMA (P221-0050) Applied Informatics, Master, ASPO 01.10.2017 , semester 1, mandatory course
PIM-BMA (P221-0050) Applied Informatics, Master, SO 01.10.2026 , semester 1, mandatory course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:
PIM-BUC Business Computing

[*updated 16.12.2025*]

Module coordinator:
Prof. Dr.-Ing. André Miede

Lecturer: Prof. Dr.-Ing. André Miede

[*updated 16.10.2016*]

Learning outcomes:
After successfully completing this module, students will have acquired the knowledge and skills to name, explain and compare classical and modern management concepts in order to operate successfully in existing management structures. In addition, they will be able to name, summarize and explain the basic concepts of management consulting, in particular the competencies and methods with which companies, divisions/departments, structures/processes and the resources used there can be evaluated and further developed. In addition, students will be able to describe the strong link to IT in both areas and the resulting opportunities and challenges.

[*updated 26.02.2018*]

Module content:
Part I: Business management
1. Introduction and overview
2. Strategy and planning
3. Organization
4. Personnel and management
5. Controlling

6. Selected special topics related to management

Part II: Consulting
1. Introduction and overview
2. Consulting markets and sub-markets
3. Consulting acquisition
4. The consulting process
5. Methods of analysis and evaluation/design and change methods
6. Selected special topics related to consulting

[*updated 26.02.2018*]

Recommended or required reading:
Part I: Business management
Harald Hungenberg, Torsten Wulf: Grundlagen der Unternehmensführung, Springer.
Bernd Lieber: Personalführung, utb.
John R. Schermerhorn: Introduction to Management, Wiley.
Tom DeMarco, Timothy Lister: Peopleware, Addison-Wesley.
Tom DeMarco: Slack, Crown Business.
Jack Welch, Suzy Wetlaufer: Winning, HarperCollins.
Gunter Dueck: Professionelle Intelligenz, Eichborn.
Gunter Dueck: Lean Brain Management, Springer.

Part II: Consulting
Christel Niedereichholz: Unternehmensberatung Band 1: Beratungsmarketing und Auftragsakquisition, Oldenbourg.
Christel Niedereichholz: Unternehmensberatung Band 2: Auftragsdurchführung und Qualitätssicherung, Oldenbourg.

[*updated 26.02.2018*]

Computability and Complexity Theory

Module name (EN): Computability and Complexity Theory

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-BK

Hours per semester week / Teaching method:
4V (4 hours per week)

ECTS credits:
6

Semester: 1

Mandatory course: yes

Language of instruction:
German

Assessment:
Oral examination

[*updated 20.12.2017*]

Applicability / Curricular relevance:

DFI-BK (P610-0278) Computer Science, Master, ASPO 01.10.2018 , semester 1, mandatory course
KIM-BK (P222-0047) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 1, mandatory course
PIM-BK (P221-0048) Applied Informatics, Master, ASPO 01.10.2011 , semester 1, mandatory course
PIM-BK (P221-0048) Applied Informatics, Master, ASPO 01.10.2017 , semester 1, mandatory course
PIM-BK (P221-0048) Applied Informatics, Master, SO 01.10.2026 , semester 1, mandatory course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Maximilian Altmeyer

Lecturer: Prof. Dr. Maximilian Altmeyer

[*updated 05.10.2016*]

Learning outcomes:
The students will be able to define the most important concepts from the computability and complexity theory and explain them using examples. They can understand the basic mathematical properties of hardware and software and are able to identify and apply theoretical concepts that solve practical problems. Students can explain the principal limitations to which certain problems are subject and analyze new problems with regard to these limitations.

The students can determine the complexity of problems regarding runtime and storage space and implement this knowledge to draw conclusions about the practical implementation of algorithms.

[*updated 20.12.2017*]

Module content:
1 Automata and languages
  * Finite and infinite automata
  * Regular expressions
  * Kleene´s recursion theorem
  * Quotient automaton
2 Computability theory
  * Turing machines
  * Church-Turing thesis
  * Generators

* Decidability
* Reduction

3 Complexity theory
* Time complexity
* NP-completeness
* Space complexity

[*updated 24.02.2018*]

Teaching methods/Media:
Lecture, exercises, discussions

[*updated 20.12.2017*]

Recommended or required reading:
SIPSER Michael: Introduction to the theory of computation, Course Technology, 3rd edition, 2012
SAKAROVITCH Jacques: Elements of Automata Theory, Cambridge University Press, 2009

[*updated 20.12.2017*]

Data Engineering

Module name (EN): Data Engineering

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-DE

Hours per semester week / Teaching method:
3V+1U (4 hours per week)

ECTS credits:
6

Semester: 2

Mandatory course: yes

Language of instruction:
German

Assessment:
Written exam, Duration 120 min.

[*updated 13.10.2024*]

Applicability / Curricular relevance:

DFI-DE (P610-0286) Computer Science, Master, ASPO 01.10.2018 , semester 2, mandatory course
KIM-DE (P222-0050) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 2, mandatory course
PIM-DE (P222-0050) Applied Informatics, Master, ASPO 01.10.2017 , semester 2, mandatory course
PIM-DE (P222-0050) Applied Informatics, Master, SO 01.10.2026 , semester 2, mandatory course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
PIM-DS Data Science

[*updated 11.12.2025*]

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Klaus Berberich

Lecturer: Prof. Dr. Klaus Berberich

[*updated 05.10.2016*]

Learning outcomes:
After successfully completing this module, students will be capable of handling large amounts of structured and unstructured data. They will know the basic structures of a (relational) database system and be familiar with implementation techniques (e. g. index structures and blocking mechanisms), as well as their benefits (e. g. query acceleration and transaction isolation). Students will be able to differentiate between transaction-oriented (OLTP) and analytical (OLAP) application scenarios. They will know the basic terms of so-called data warehouses and can express analytical information requirements in a suitable query language (e. g. SQL and MDX). Students will be familiar with basic information retrieval models (e. g. vector space model) and can apply them to sample data, in order to master unstructured data (e. g. text documents). They will be familiar with quality criteria (e. g. precision and yield) and can calculate them for the determined results. Students will be familiar with data mining methods, such as the analysis of shopping carts, as a means of gaining knowledge from data. Students will be capable of systematically determining the parameters of such procedures and critically assessing the results. Students will be familiar with the platforms available for distributed data processing, (e. g. MapReduce and Spark). They will be able to select a suitable platform for a given analytical task and implement the task using this platform.

[*updated 24.02.2018*]

Module content:
1. Introduction

2. Database systems
2.1 Architecture
2.2 Buffer management
2.3 Access structures
2.4 Query processing
2.5 Transaction management

3. Data warehouses
3.1 Modeling
3.2 Data integration
3.3 Query languages
3.4 Implementation aspects

4. Information retrieval
4.1 Retrieval models
4.2 Quality criteria and evaluation
4.3 Implementation aspects

5. Data mining
5.1 Classification
5.2 Clustering
5.3 Association rule learning

6. Big data
6.1 Platforms (e.g. MapReduce and Spark)
6.2 Interfaces (e.g. Pig and Hive)
6.3 Implementation of selected procedures (e.g. k-Means and PageRank)

[*updated 13.10.2024*]

Teaching methods/Media:
Transparencies, practical and theoretical exercises

[*updated 20.12.2017*]

Recommended or required reading:
Kemper Alfons und Eickler André: Datenbanksysteme - Eine Einführung, De Gruyter, 2015

Saake Gunter und Sattler Kai-Uwe: Databases: Implementierungstechniken, mitp Professional, 2011

Martin Kleppmann: Designing Data-Intensive Applications, O Reilly, 2017

Garcia-Molina Hector, Widom Jennifer, Ulmman Jeffrey D.: Database Systems: The Complete Book, Pearson Education, 2013

Leskovec Jure, Rajaraman Anand und Ullman Jeffrey D.: Mining of Massive Datasets, Cambridge University Press, 2014

[*updated 13.10.2024*]

Data Science

Module name (EN): Data Science

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-DS

Hours per semester week / Teaching method:
3V+1U (4 hours per week)

ECTS credits:
6

Semester: 1

Mandatory course: yes

Language of instruction:
German

Assessment:
Written exam, Duration 120 min.

[*updated 13.10.2024*]

Applicability / Curricular relevance:

DFI-DS (P610-0280) Computer Science, Master, ASPO 01.10.2018 , semester 1, mandatory course
KIM-DS (P221-0051) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , optional course, informatics specific
PIM-DS (P221-0051) Applied Informatics, Master, ASPO 01.10.2017 , semester 1, mandatory course
PIM-DS (P221-0051) Applied Informatics, Master, SO 01.10.2026 , semester 1, mandatory course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:
PIM-DE Data Engineering

[*updated 11.12.2025*]

Module coordinator:
Prof. Dr. Klaus Berberich

Lecturer: Prof. Dr. Klaus Berberich

[*updated 05.10.2016*]

Learning outcomes:
After successfully completing this module, students will be able to use suitable methods of data analysis to gain knowledge for decision-making in practical questions. Students will become familiar with important data analysis procedures. They will be familiar with different types of characteristics (e. g. nominal, ordinal, metric) and can preprocess data appropriately (e. g. by normalization or standardization). Students will be able to select appropriate decision-making procedures (e.g. regression or classification) for specific problems. They will be able to implement the procedures they have learned in a suitable programming language (e. g. Python) or use an available implementation. Students will be able to systematically determine the parameters of the applied methods on the basis of available data and critically assess the quality of their

results. They will be able to prepare the knowledge gained from the data appropriately (e. g. in the form of visualization) in order to make it understandable for a technically trained or non-technically trained audience (e. g. decision-makers in the company).

[*updated 13.10.2024*]

Module content:
1. Introduction

2. Regression
2.1 Linear regression
2.2 Feature transformation
2.3 Regularization

3. Classification
3.1 Logistic regression
3.2 Decision trees
3.3 Naive Bayes
3.4 Support vector machines

4. Cluster analysis
4.1 Representative method (k-Means und k-Medoids)
4.2 Hierarchical method
4.3 Density-based method

5. 5.3 Association rule learning
5.1 Finding frequent item sets (Apriori and FP-Growth)
5.2 Determining association rules
5.3 Finding frequent sequences (GSP and PrefixSpan)
5.4 Finding frequent strings
5.5 Finding frequent subgraphs

6. Neural Networks
6.1 Perceptron
6.2 Multi-layer neural networks (MLPs)
6.3 Convolutional neural networks (CNNs)
6.4 Recurrent neural networks (RNNs)

7. Data visualization

[*updated 13.10.2024*]

Teaching methods/Media:
Transparencies, practical and theoretical exercises

[*updated 24.02.2018*]

Recommended or required reading:
Aggarwal C.: Data Mining - The Textbook, Springer, 2015

Harrington P.: Machine Learning in Action, Manning, 2012

Kelleher J., Mac Namee B. und D"Arcy A.: Fundamentals of Machine Learning for Predictive Data Analytics, MIT Press, 2015

Provost F. und Fawcett T.: Data Science for Business, O"Reilly, 2013

Raschka S.: Machine Learning mit Python, mitp, 2017

Zaki Mohammed J. und Meira Wagner Jr: Data Mining and Analysis: Fundamental Concepts and Algorithms, Cambridge University Press, 2020

[*updated 13.10.2024*]

Discrete Mathematics

Module name (EN): Discrete Mathematics

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-DM

Hours per semester week / Teaching method:
3V+1U (4 hours per week)

ECTS credits:
6

Semester: 1

Mandatory course: yes

Language of instruction:
German

Assessment:
Exam

[*updated 30.06.2024*]

Applicability / Curricular relevance:

DFI-DM (P610-0269) Computer Science, Master, ASPO 01.10.2018 , semester 1, optional course
KI873 Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 2, optional course, informatics specific
KIM-DM (P222-0051) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 1, mandatory course
PIM-DM (P222-0051) Applied Informatics, Master, ASPO 01.10.2011 , semester 2, mandatory course
PIM-DM (P222-0051) Applied Informatics, Master, ASPO 01.10.2017 , semester 1, mandatory course
PIM-DM (P222-0051) Applied Informatics, Master, SO 01.10.2026 , semester 1, mandatory course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Peter Birkner

Lecturer: Prof. Dr. Peter Birkner

[*updated 05.10.2016*]

Learning outcomes:

After successfully completing this module, students will have improved their knowledge about the concept of divisibility in the area of whole numbers. They will be able to recognize and apply divisibility relationships. Students will have worked with the lecturer to derive the congruence relation from divisibility. They will be familiar with the concept of the remainder class and will be able to calculate its inverse. They will be able to analyze the structure of residue class groups.

Students will be familiar with the Chinese Remainder Theorem. They will be able to derive the general proof from the proof for 2 equations. They will be able to apply the Chinese Remainder Theorem to specific tasks and use it to solve practical problems.

Students will be able to explain what prime numbers are. They will be able to estimate the number of prime numbers below a given threshold. They will be able to use a primality test to check whether a natural number is prime or not. They will be able to recognize pseudoprimes and know what this means for the primality test.

They will have improved their knowledge about the group theory. They will be familiar with various properties and structures, such as order, (cyclic) subgroup, generator, etc. They will be able to recognize these structures and apply them in different contexts.

Students will be able to identify the problem of the discrete logarithm. They will be able to solve it independently using the baby-step giant-step algorithm and perform the Diffie-Hellman protocol as an application.

The students will be able to explain what an elliptic curve is and know how to add points to it. They will be able to recognize the group structure in the set of points and apply both the field theory and the Diffie-Hellman protocol to elliptic curves.

[*updated 30.06.2024*]

Module content:

1. Module arithmetics
Divisibility, congruences, efficient modular exponentiation mod p, divisibility rules, residue classes, inverse residue classes, residue class groups, Euler´s phi function and its calculation

2. The Chinese Remainder Theorem (CRT)
CRT for 2 equations, CRT in general, examples and applications

3. Prime numbers

Prime numbers, fundamental theorem of algebra, there are infinitely many prime numbers, prime number theorem, Fermat´s little theorem, Fermat primality test, pseudoprimes

4. Group theory
Group axioms, subgroups, exponentiation in groups, cyclic groups, ordering of elements and groups, homomorphisms, kernel and image

5. The discrete logarithm (DL)
The DL, Square and Multiply Method, Shanks Baby-Step Giant-Step Algorithm, the Diffie-Hellman-Protocol

6. Field theory
Finite bodies, characteristics

7. Elliptic curves (EC)
EC, points on the EC, Weierstrass equation, group law, graphical addition, discriminant, number of points of an EC over F_p, the Hasse-Weil interval

[*updated 30.06.2024*]

Recommended or required reading:

- Ziegenbalg: Elementare Zahlentheorie (Beispiele, Geschichte, Algorithmen) Springer, 2015

- Washington: Elliptic Curves (Number Theory and Cryptography), Chapman& Hall, 2008

- Iwanowski, Lang: Diskrete Mathematik mit Grundlagen (Lehrbuch für Studierende von MINT-Fächern), Springer, 2014

[*updated 30.06.2024*]

Master Thesis

Module name (EN): Master Thesis

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-MT

Hours per semester week / Teaching method:
-

ECTS credits:
30

Semester: 4

Mandatory course: yes

Language of instruction:
German

Assessment:
Written composition (ca. 60-120 Seiten)
Presentation with oral defense (40-45 min incl. demo and discussion)

[*updated 17.04.2025*]

Applicability / Curricular relevance:

KIM-MT (T222-0058) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 4, mandatory course
PIM-MT (T221-0054) Applied Informatics, Master, ASPO 01.10.2011 , semester 4, mandatory course
PIM-MT (T221-0054) Applied Informatics, Master, ASPO 01.10.2017 , semester 4, mandatory course
PIM-MT (T221-0054) Applied Informatics, Master, SO 01.10.2026 , semester 4, mandatory course

Suitable for exchange students (learning agreement)

Workload:
The total student study time for this course is 900 hours.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Studienleitung

Lecturer: Studienleitung

[*updated 05.10.2016*]

Learning outcomes:
After successfully completing this module, students will:
be able to achieve their own research and development results that identify them as academic personalities who are open to innovative technologies and their applications.
be able to apply and develop the latest findings from research and development.
gain new research and development insights on the basis of their knowledge and be capable of translating these insights into concepts and solutions that they can then present.
be able to analyze issues, as well as design and implement appropriate solutions in cooperation with external and internal clients and colleagues.
And lastly, students will be able to document the results of their work in writing according to scientific principles.

[*updated 17.04.2025*]

Module content:
1 Problem definition
2 Development of new theoretical and application-specific tenets
3 Evaluation of alternative solutions, also based on interim research results
4 Independent development of concepts and solutions for the task
5 Documentation of results in the form of a Master thesis
6 Presentation of the Master thesis within the framework of a colloquium

[*updated 26.02.2018*]

Recommended or required reading:
Independent selection of literature depending on the topic.

[*updated 26.02.2018*]

Project work

Module name (EN): Project work

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-PA

Hours per semester week / Teaching method:
2PA (2 hours per week)

ECTS credits:
6

Semester: 2

Mandatory course: yes

Language of instruction:
German

Assessment:
Project work 80%, oral examination 20%

[*updated 14.05.2025*]

Applicability / Curricular relevance:

PIM-PA (P221-0056) Applied Informatics, Master, ASPO 01.10.2011 , semester 3, mandatory course
PIM-PA (P221-0056) Applied Informatics, Master, ASPO 01.10.2017 , semester 3, mandatory course
PIM-PA (P221-0056) Applied Informatics, Master, SO 01.10.2026 , semester 2, mandatory course

Suitable for exchange students (learning agreement)

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 157.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Professor/innen des Studiengangs

Lecturer: Professor/innen des Studiengangs

[*updated 05.10.2016*]

Learning outcomes:
After successfully completing this module, students will:
have developed their own competences in conceiving, working on and presenting IT projects.
be in a position to apply the latest findings from their special field to larger problems.
have gained new insights on the basis of their knowledge and be capable of translating these into concepts and solutions that they can then present.
have mastered the skills required for team leadership, teamwork and conflict management.

[*updated 14.05.2025*]

Module content:
1 Working on complex projects
2 Coordinating task definitions with the project s client
3 Analyzing problems and creating a project plan
4 Working on each project step according to the project plan and scheduling regular reviews with the client of the project and the supervising professors.
5 Documenting project results
6 Presenting project results

[*updated 14.05.2025*]

Recommended or required reading:
Project-related literature will be specified by the lecturer resp. researched independently.

[*updated 26.02.2018*]

Software Architecture

Module name (EN): Software Architecture

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-SAR

Hours per semester week / Teaching method:
2PA+2S (4 hours per week)

ECTS credits:
6

Semester: 1

Mandatory course: yes

Language of instruction:
German

Assessment:
Project

[*updated 20.12.2017*]

Applicability / Curricular relevance:

DFI-SAR (P610-0279) Computer Science, Master, ASPO 01.10.2018 , semester 1, mandatory course
KI747 Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 1, optional course, informatics specific
KIM-SAR (P221-0059) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 1, optional course
PIM-SAR (P221-0059) Applied Informatics, Master, ASPO 01.10.2011 , semester 1, mandatory course
PIM-SAR (P221-0059) Applied Informatics, Master, ASPO 01.10.2017 , semester 1, mandatory course
PIM-SAR (P221-0059) Applied Informatics, Master, SO 01.10.2026 , semester 1, mandatory course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Markus Esch

Lecturer: Prof. Dr. Markus Esch

[*updated 05.10.2016*]

Learning outcomes:
After successfully completing this module, students will be capable of naming the basic concepts and methods of software architecture. They will be able to describe the tasks and role of a software architect in a project team and understand the importance of software architecture in large software projects.

They will be capable of deriving properties of a software architecture from user requirements and of developing and documenting a design using modern architectural approaches. In addition, they will also be able to analyze the advantages and disadvantages of an architecture and derive potential for improvement.

In the case studies accompanying the lectures, students will learn to work independently in small groups. They will be able to present their results and to document them in the form of a scientific publication.

[*updated 24.02.2018*]

Module content:
- Requirements for a software architecture
- The role and tasks of a software architect
- Process models
- Architectural views
- Architecture styles and patterns
- The documentation of a software architecture

[*updated 20.12.2017*]

Teaching methods/Media:
Lecture slides, annotated lecture slides as a script

[*updated 20.12.2017*]

Recommended or required reading:
Len BASS, Rick KAZMAN, Paul CLEMENTS: Software Architecture in Practice, Addison Wesley, 3rd Edition 2012

Gernot STARKE: Effektive Softwarearchitekturen: Ein praktischer Leitfaden, Hanser Verlag, 7. Auflage, 2015

Stefan ZÖRNER: Softwarearchitekturen dokumentieren und kommunizieren: Entwürfe, Entscheidungen und Lösungen nachvollziehbar und wirkungsvoll festhalten, Hanser Verlag, 2. Auflage, 2015

Rick KAZMAN, Humberto CERVANTES: Designing Software Architectures - A Practical Approach, Addison Wesley, 2016

George FAIRBANKS: Just Enough Software Architecture: A Risk-Driven Approach, Marshall & Brainerd, 2010

[*updated 30.07.2021*]

Applied Informatics Master - optional courses

"Engineering Visions" and Intercultural Experience Intensive Program

Module name (EN): "Engineering Visions" and Intercultural Experience Intensive Program

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-EVIE

Hours per semester week / Teaching method:
3PA+1S (4 hours per week)

ECTS credits:
4

Semester: 2

Mandatory course: no

Language of instruction:
English

Assessment:
Project presentation and composition

[*updated 20.12.2017*]

Applicability / Curricular relevance:

KIM-EVIE (P221-0134) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 2, optional course, general subject
PIM-EVIE (P221-0134, P610-0455) Applied Informatics, Master, ASPO 01.10.2017 , semester 2, optional course, not informatics specific
PIM-EVIE (P221-0134, P610-0455) Applied Informatics, Master, SO 01.10.2026 , semester 2, optional course, not informatics specific

Suitable for exchange students (learning agreement)

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 120 hours (equivalent to 4 ECTS credits).
There are therefore 75 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Martin Löffler-Mang

Lecturer: Prof. Dr. Martin Löffler-Mang

[*updated 01.06.2017*]

Learning outcomes:
After successfully completing this module, students will be able to analyze and evaluate global challenges. They will have acquired new working techniques that will help them develop innovative and technical visions for the future. They will be familiar with the most important basic concepts of conscious communication and discussions in multidisciplinary work. They can present and document work results in an appropriate manner. In addition, students will have expanded their intercultural and foreign language skills through work in international teams. Finally, they will be able to guide and head up a small team of students.

[*updated 24.02.2018*]

Module content:
Students will discuss the challenges of today´s world and develop technical visions for what they believe life on earth will be like in 25 to 50 years. In international project groups, they will develop and discuss their

own technical visions from fields such as bionics, mechatronics, nanotechnology, intelligent materials, renewable energies, optical technologies and information technologies (selection) for a sustainable life on earth.

[*updated 24.02.2018*]

Teaching methods/Media:
The initial phase will focus on inspiring, future-oriented lectures by our speakers on technical topics of the future. The goal of these lectures is to motivate the students and inspire their conceptual work. The lectures will be accompanied by workshops on creative techniques (brainstorming, mind mapping, World Café etc.) and team building.
During the main phase, students will work autonomously in groups supported by mentors (lecturers from our partner universities). At the end of each day, together with the lecturers, he students will reflect on their own results, as well as those from the other groups.
The intensive program will end with a presentation and self-assessment of each group´s results in the form of a marketplace.

[*updated 24.02.2018*]

Recommended or required reading:
Project-related literature

[*updated 20.12.2017*]

Advanced Presentation and Writing Skills for ICT Studies

Module name (EN): Advanced Presentation and Writing Skills for ICT Studies

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-APWS

Hours per semester week / Teaching method:
2V (2 hours per week)

ECTS credits:
3

Semester: 2

Mandatory course: no

Language of instruction:
English

Assessment:
50% oral presentation with grade (10 minutes),
50% written composition with grade

[*updated 24.02.2018*]

Applicability / Curricular relevance:

KI837 Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 1, optional course, general subject
KIM-APWS (P222-0086) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 2, optional course, general subject
PIM-WN42 (P222-0085) Applied Informatics, Master, ASPO 01.10.2011 , semester 1, optional course, not informatics specific
PIM-APWS (P222-0086) Applied Informatics, Master, ASPO 01.10.2017 , semester 2, optional course, general subject
PIM-APWS (P222-0086) Applied Informatics, Master, SO 01.10.2026 , semester 2, optional course, general subject

Suitable for exchange students (learning agreement)

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 90 hours (equivalent to 3 ECTS credits).
There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Dipl.-Übers. Betina Lang

Lecturer: Dipl.-Übers. Betina Lang

[*updated 10.11.2016*]

Learning outcomes:
On the basis of the knowledge acquired in the mandatory Bachelor modules, this module focuses on the written and oral presentation of scientific ideas in team meetings and at conferences such as the IEEE Students´ Conferences.
To this end, students will first acquire the linguistic skills and knowledge necessary for writing scientific papers. Based on their papers, they will learn to develop strategies for the conception of lectures and posters, as well as the linguistic means for their design and presentation.
A communicative-pragmatic approach will be taken here. Students will also deepen their previously acquired knowledge about appropriate intercultural communication in English-speaking countries and English as a bridge language. All of the four basic skills (reception, production, interaction and mediation) will be trained in an integrated manner. Content development is supported by the repetition of the relevant linguistic structures and special features. Whenever possible, content from the English-language electives in the Master program will be used.

[*updated 24.02.2018*]

Module content:
- Academic writing: Types of text, form, structure, language requirements
- The description of graphics and tables
- Strategies for team writing and peer review
- Discussion techniques (useful phrases and intercultural skills)
- Presentation (structure and useful phrases)
- Presentation slides, posters
- Grammar as required

[*updated 24.02.2018*]

Teaching methods/Media:
Teaching and learning materials for specific target groups (print, audio, video), multimedia teaching and learning software

[*updated 24.02.2018*]

Recommended or required reading:
Students will receive a list of recommended teaching and learning materials.

[*updated 24.02.2018*]

Advanced Topics in Data Science & Engineering

Module name (EN): Advanced Topics in Data Science & Engineering

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-ATDE

Hours per semester week / Teaching method:
2V (2 hours per week)

ECTS credits:
3

Semester: 1

Mandatory course: no

Language of instruction:
German

Assessment:

[*still undocumented*]

Applicability / Curricular relevance:

KIM-ATDE Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 1,

optional course, telecommunications-specific
PIM-ATDE (P221-0151) Applied Informatics, Master, ASPO 01.10.2017 , semester 1, optional course, informatics specific
PIM-ATDE (P221-0151) Applied Informatics, Master, SO 01.10.2026 , semester 1, optional course, informatics specific

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 90 hours (equivalent to 3 ECTS credits).
There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Klaus Berberich

Lecturer: Prof. Dr. Klaus Berberich

[*updated 11.07.2018*]

Learning outcomes:

[*still undocumented*]

Module content:

[*still undocumented*]

Recommended or required reading:

[*still undocumented*]

Astronomy Seminar

Module name (EN): Astronomy Seminar

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-ASTR

Hours per semester week / Teaching method:
1V+1PA (2 hours per week)

ECTS credits:
2

Semester: 1

Mandatory course: no

Language of instruction:
German

Assessment:
Presentation, composition

[*updated 20.12.2017*]

Applicability / Curricular relevance:

KI752 (P231-0115) Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 1, optional course, general subject
KIM-ASTR (P231-0114) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 1, optional course, general subject
MTM.AST (P231-0114) Mechatronics, Master, ASPO 01.04.2020 , optional course
MAM.2.1.1.1 (P231-0114) Engineering and Management, Master, ASPO 01.10.2013 , semester 9, optional course
MST.AST Mechatronics and Sensor Technology, Master, ASPO 01.04.2016 , optional course, course inactive since 27.10.2015
PIM-WN22 (P231-0115) Applied Informatics, Master, ASPO 01.10.2011 , semester 1, optional course, not informatics specific
PIM-ASTR (P231-0114) Applied Informatics, Master, ASPO 01.10.2017 , semester 1, optional course, not informatics specific
PIM-ASTR (P231-0114) Applied Informatics, Master, SO 01.10.2026 , semester 1, optional course, not informatics specific
MST.AST Mechatronics and Sensor Technology, Master, ASPO 01.10.2011 , semester 9, optional course

Suitable for exchange students (learning agreement)

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 60 hours (equivalent to 2 ECTS credits).
There are therefore 37.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Martin Löffler-Mang

Lecturer: Prof. Dr. Martin Löffler-Mang

[*updated 10.11.2016*]

Learning outcomes:
After successfully completing this module, students will be able to read and understand complex articles from specialist journals (e. g."Sterne und Weltraum" or "Spektrum der Wissenschaften"). Based on what

they have read, students will give a talk of approx. 60 minutes on a self-chosen astronomical topic and defend it in a discussion group. In addition, they will also actively participate in the discussion and ask questions on their classmates´ topics.

[*updated 24.02.2018*]

Module content:
Current topics from the field of astronomy, such as for example:

+ In the depths of space and time
+ Where did Saturn get its rings from?
+ Omega Centauri - a superlative globular cluster
+ Gravitational waves
+ How galaxies form
+ Neutron stars and black holes
+ Last year´s comets
+ The current state of large telescopes
+ Radio astronomy: LOFAR results from meteorology to cosmology
+ The formation of periodic meteor showers

[*updated 24.02.2018*]

Teaching methods/Media:
Literature research, lecture and independent observation

[*updated 20.12.2017*]

Recommended or required reading:
Kosmos-Himmelsjahr (almanac)
Sterne und Weltraum (monthly journal)
Spektrum der Wissenschaften (professional journal)

[*updated 24.02.2018*]

Automotive Engineering

Module name (EN): Automotive Engineering

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-ATEC

Hours per semester week / Teaching method:
2V+2P (4 hours per week)

ECTS credits:
6

Semester: 1

Mandatory course: no

Language of instruction:
German

Assessment:
Composition and written exam

[*updated 26.02.2018*]

Applicability / Curricular relevance:

E1984 (P200-0029) Electrical Engineering, Master, ASPO 01.10.2013 , optional course, technical
KI851 Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 2, optional course, telecommunications-specific
KIM-ATEC (P200-0029, P200-0030) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 1, optional course, telecommunications-specific
PIM-WI74 Applied Informatics, Master, ASPO 01.10.2011 , semester 2, optional course, not informatics specific
PIM-ATEC (P200-0029) Applied Informatics, Master, ASPO 01.10.2017 , semester 1, optional course, not informatics specific
PIM-ATEC (P200-0029) Applied Informatics, Master, SO 01.10.2026 , semester 1, optional course, not informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Horst Wieker

Lecturer: Prof. Dr. Horst Wieker

[*updated 10.11.2016*]

Learning outcomes:
Students will be able to name the advantages and disadvantages of the most common bus systems, as well as their various fields of application. They will be able to encode/decode simple sensor and actuator information on the CAN bus and understand and adapt predefined addressing schemes. When problems occur, students will be able to systematically search for errors. In addition, students will be able to list the data typically generated in modern vehicles and the connections between this data and assistance systems.

They will be capable of demonstrating the basic motivation behind Cooperative Intelligent Transports Systems (car-2-car). Students will be able to reconstruct basic standard use cases and, based on given scenarios, independently determine how messages must to be composed in order to implement the applications. Students will be capable of solving routing problems by calculating the best propagation path.

[*updated 26.02.2018*]

Module content:
* Car-2-Car and GeoNetworking (theory)

* CAN Bus in detail (theory)

* CAN Bus in detail (practice)

* FlexRay Bus in detail (practice)

* Car-2-Car and GeoNetworking (practice)
  - Wrong-way driver warning
  - Traffic light assistant
  - Intersection assistant
  - Emergency vehicle warning system

* Communication-based assistance systems

[*updated 26.02.2018*]

Recommended or required reading:

[*still undocumented*]

Bioinformatics

Module name (EN): Bioinformatics

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-BIOI

Hours per semester week / Teaching method:
4V (4 hours per week)

ECTS credits:
6

Semester: 2

Mandatory course: no

Language of instruction:
German

Assessment:
Project and presentation

[*updated 20.12.2017*]

Applicability / Curricular relevance:

KI850 Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 2, optional course, informatics specific
KIM-BIOI (P221-0152) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 2, optional course, informatics specific
MP2106.BIOI Medical Physics, Master, ASPO 01.04.2019 , semester 1, optional course
MP2106.BIOI Medical Physics, Master, SO 01.10.2025 , semester 1, optional course
PIM-WI57 Applied Informatics, Master, ASPO 01.10.2011 , semester 2, optional course, informatics specific
PIM-BIOI (P221-0152) Applied Informatics, Master, ASPO 01.10.2017 , semester 2, optional course, informatics specific
PIM-BIOI (P221-0152) Applied Informatics, Master, SO 01.10.2026 , semester 2, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Gerald Kroisandt

Lecturer: Prof. Dr. Gerald Kroisandt

[*updated 10.11.2016*]

Learning outcomes:
Students will be familiarized with several application areas of bioinformatics and will be able to efficiently solve typical problems such as the sequencing of genomes or the structure of proteins using algorithms.

[*updated 20.12.2017*]

Module content:
Computer-aided research in the natural sciences (biology, pharmacy, biotechnology,...) generates large amounts of data that must be archived and analyzed. This requires efficient algorithms.

First, the algorithms used in the sequencing of the human genome will be introduced in the lecture. Then, methods for the identification of genes (gene prediction) will be described. Hidden Markov models are an important part of this process. The methods discussed make it possible to predict the 3-D structure and function of proteins.

In conclusion, we will discuss the algorithms and procedures used by pharmaceutical companies in the computer-aided search for new active ingredients (computer-aided drug design).

1. Basics
2. Genome sequencing algorithms
3. Hidden Markov models

4. The application of hidden Markov models for the identification of genes
5. Protein structure predictions and databases
6. Computer-aided drug design

[*updated 24.02.2018*]

Teaching methods/Media:
50% of the lecture will take place in the PC lab AMSEL "Angewandte Mathematik, Statistik und eLearning". Computer-supported practical case studies will be worked through using the algorithms taught in this module.
In addition, the e-learning system ActiveMath: Statistics will be used to learn about topics from the field of stochastics, especially the Markov models.

[*updated 24.02.2018*]

Recommended or required reading:
BALDI, BRUNAK: Bioinformatics, The Machine Learning Approach

[*updated 20.12.2017*]

Building Systems Technology

Module name (EN): Building Systems Technology

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-GSYS

Hours per semester week / Teaching method:
4V (4 hours per week)

ECTS credits:
6

Semester: 1

Mandatory course: no

Language of instruction:
German

Assessment:
Written exam, composition

[*updated 26.02.2018*]

Applicability / Curricular relevance:

KI741 Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 1, optional course, telecommunications-specific
KIM-GSYS (P222-0084) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 1, optional course, telecommunications-specific
PIM-WI79 (P222-0084) Applied Informatics, Master, ASPO 01.10.2011 , semester 1, optional course, informatics specific
PIM-GSYS Applied Informatics, Master, ASPO 01.10.2017 , semester 1, optional course, informatics specific
PIM-GSYS Applied Informatics, Master, SO 01.10.2026 , semester 1, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Michael Igel

Lecturer: Prof. Dr. Michael Igel

[*updated 10.11.2016*]

Learning outcomes:
After successfully completing the course, students will have acquired basic theoretical knowledge of communication technology in residential and functional buildings,
as well as building systems technology. In addition, students will be able to apply the knowledge they have acquired to carry out practical planning projects and to develop and document technical solutions for a given task in the field of building systems technology.

Conceptional application of concepts from building systems technology

The automation of processes in functional and residential buildings using EIB

Planning and implementation of network topologies based on the EIB

Analysis of protocols and EIB telegrams

Process-related selection and project planning of EIB actuators and sensors

[*updated 26.02.2018*]

Module content:
1 Basics of communication technology
1.1 Serial data transmission
1.2 Asynchronous and synchronous communication protocols
1.3 Data flow control
1.4 Data backup (Hamming distance)

1.5 OSI model and EIB system
2 Modern building installation technology
2.1 Requirements on modern building installations
2.2 Limits of the conventional installation, advantages of the EIB system
2.3 Conventional installation

[*updated 14.05.2025*]

Recommended or required reading:
EIB für die Gebäudesystemtechnik, Michael Rose, Hüthig
Installationsbus EIB/KNX Twisted Pair, Robert Beiter, Hüthig & Pflaum
Elektro-Installation in Gebäuden, Dieter Vogt, VDE Verlag
Training materials from different manufacturers

[*updated 26.02.2018*]

Content Management Systems

Module name (EN): Content Management Systems

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-CMS

Hours per semester week / Teaching method:
2V+2PA (4 hours per week)

ECTS credits:
6

Semester: 1

Mandatory course: no

Language of instruction:
German

Assessment:
Project work

[*updated 08.05.2008*]

Applicability / Curricular relevance:

DFI-CMS Computer Science, Master, ASPO 01.10.2018 , semester 1, optional course, informatics specific, course inactive since 31.03.2023
KI743 Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 1, optional course, informatics specific
KIM-CMS (P221-0136, P221-0137) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 1, optional course, informatics specific
PIM-WI15 (P221-0136) Applied Informatics, Master, ASPO 01.10.2011 , semester 1, optional course, informatics specific

PIM-CMS (P221-0137) Applied Informatics, Master, ASPO 01.10.2017 , semester 1, optional course, informatics specific
PIM-CMS (P221-0137) Applied Informatics, Master, SO 01.10.2026 , semester 1, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Dipl.-Inform. Roman Jansen-Winkeln

Lecturer: Dipl.-Inform. Roman Jansen-Winkeln

[*updated 10.11.2016*]

Learning outcomes:
After successfully completing this module, students will have an overview of the existing CMS systems and be able to use them competently. They will be able to work with a CMS, i. e. collect content, customize its appearance and add and develop modules. Students will learn about template languages, skins and scripts and be able to use them. Depending on the application, students will be able to select and set up the appropriate infrastructure, e. g. with proxies, caches or as a server farm. With the topics of search engine optimization, enterprise CMS, Social Software and Web 2.0 they will acquire additional knowledge that they can use appropriately depending on the situation.

The goal of this module is to teach students to evaluate, adapt and use content management systems. In addition, they should also be able to introduce these systems and advise others on their use. Exercises, regular short presentations and project work in teams will help solidify the students knowledge and skills.

[*updated 14.05.2025*]

Module content:
1. Foundation

Plone/Zope/Python
Communication via the web
Representation in the computer

2. Using and adapting a CMS

Hello World: initial content
Template languages, sever-based scripting
Skins
Custom content types

3. CMS infrastructures

CMS operation
Search engines and search engine optimization
User management
Fat clients, single page applications

4. Using CMS

Classic applications
Enterprise CMS
Web 2.0 applications
Financing CMS platforms
Legal framework

[*updated 26.02.2018*]

Recommended or required reading:
Aspeli, Martin: Professional Plone Development, Packt Publishing Ltd., 2007
ASPELI, Martin: Professional Plone 4 Development, Packt Publishing Ltd., 2011
CLARK, Alex / DE STEFANO, John (u. a.): Practical Plone 3, Packt Publishing Ltd., 2009

[*updated 26.02.2018*]

Cryptography Engineering

Module name (EN): Cryptography Engineering

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-CE

Hours per semester week / Teaching method:
2V+2P (4 hours per week)

ECTS credits:
6

Semester: 2

Mandatory course: no

Language of instruction:
German

Assessment:
Written exam, 90 min.

[*updated 04.09.2023*]

Applicability / Curricular relevance:

DFI-CE (P610-0273) Computer Science, Master, ASPO 01.10.2018 , semester 2, optional course,

informatics specific
KIM-CE (P221-0154) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 2, mandatory course
PIM-CE (P221-0154) Applied Informatics, Master, ASPO 01.10.2017 , semester 2, optional course, informatics specific
PIM-CE (P221-0154) Applied Informatics, Master, SO 01.10.2026 , semester 2, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Damian Weber

Lecturer: Prof. Dr. Damian Weber

[*updated 27.09.2016*]

Learning outcomes:
After successfully completing this module, students will be able to assess the security of symmetric, as well as public-key cryptosystems against typical types of attacks.

They will be able to configure cryptosystems, understand their implementation and point out possible weaknesses.

After a detailed analysis, they will be able to draw up a proposal to increase the security level for a given application scenario.

[*updated 04.09.2023*]

Module content:
1. Basics, terms and definitions
2. RSA
3. Diffie-Hellman key exchange
4. ElGamal encryption and signature scheme
5. Elliptic curve cryptography
6. Cryptographic hash functions
7. Digital signatures (RSA, DSA, ECDSA)
8. Symmetrical cryptography methods (stream ciphers, block ciphers)

[*updated 19.05.2023*]

Recommended or required reading:
Ferguson, Cryptography Engineering: Design Principles and Practical Applications, Wiley, 2010
Paar, Understanding Cryptography: A Textbook for Students and Practitioners, Springer, 2011

Katz, Lindell, Introduction to Modern Cryptography, 2014

[*updated 26.02.2018*]

Cryptography Project

Module name (EN): Cryptography Project

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-PKRY

Hours per semester week / Teaching method:
4PA (4 hours per week)

ECTS credits:
6

Semester: 1

Mandatory course: no

Language of instruction:
German

Assessment:
Project, documentation and presentation

[*updated 26.02.2018*]

Applicability / Curricular relevance:

KI750 (P222-0095) Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 1, optional course, informatics specific
KIM-PKRY (P222-0095) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 1, optional course, informatics specific
PIM-WI61 (P222-0095) Applied Informatics, Master, ASPO 01.10.2011 , semester 1, optional course, informatics specific
PIM-PKRY (P222-0095) Applied Informatics, Master, ASPO 01.10.2017 , semester 1, optional course, informatics specific
PIM-PKRY (P222-0095) Applied Informatics, Master, SO 01.10.2026 , semester 1, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Damian Weber

Lecturer: Prof. Dr. Damian Weber

[*updated 10.11.2016*]

Learning outcomes:
After successfully completing this module, students will be able to analyze and evaluate cryptographic procedures and correct their weak points.

In order to understand the properties of a cryptographic algorithm, we will first demonstrate them based on the implementation of a theoretical specification. Students will be able to break down procedures into their logical components and illustrate their application problems by comparing them with known procedures. They will be capable of deriving attack techniques from theoretical results or generating new ones. Lastly, they will be able to assess the security of a procedure or a modification thereof.

[*updated 26.02.2018*]

Module content:
Implementing and attacking cryptographic methods, that
* are currently being researched or
* currently have security vulnerabilities or
* are currently being used or
* are historically relevant or
* are part of the "Cryptography Engineering" module

[*updated 26.02.2018*]

Recommended or required reading:
Project-related literature will be announced at a later time.

[*updated 26.02.2018*]

Deep Learning

Module name (EN): Deep Learning

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-DL

Hours per semester week / Teaching method:
2V+2P (4 hours per week)

ECTS credits:
6

Semester: 3

Mandatory course: no

Language of instruction:
English

Assessment:

[*still undocumented*]

Applicability / Curricular relevance:

E2831 (P221-0155) Electrical Engineering and Information Technology, Master, ASPO 01.04.2019 , optional course, technical
KIM-DL (P221-0155) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , optional course, informatics specific
PIM-DL (P221-0155) Applied Informatics, Master, ASPO 01.10.2017 , semester 3, optional course, informatics specific
PIM-DL (P221-0155) Applied Informatics, Master, SO 01.10.2026 , semester 3, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Klaus Berberich

Lecturer: Prof. Dr. Klaus Berberich

[*updated 19.02.2020*]

Learning outcomes:

[*still undocumented*]

Module content:

[*still undocumented*]

Recommended or required reading:

[*still undocumented*]

Distributed Algorithms and Applications

Module name (EN): Distributed Algorithms and Applications

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-VAA

Hours per semester week / Teaching method:
2P+2S (4 hours per week)

ECTS credits:
6

Semester: 1

Mandatory course: no

Language of instruction:
German

Assessment:
Written exam

[*updated 20.12.2017*]

Applicability / Curricular relevance:

KIM-VAA (P222-0072) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 1, mandatory course
PIM-VAA (P222-0072) Applied Informatics, Master, ASPO 01.10.2017 , semester 1, optional course, informatics specific
PIM-VAA (P222-0072) Applied Informatics, Master, SO 01.10.2026 , semester 1, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Markus Esch

Lecturer: Prof. Dr. Markus Esch

[*updated 29.06.2017*]

Learning outcomes:
After successfully completing this module, students will be able to name the basic properties of distributed algorithms and applications and to describe common models for describing distributed systems. They will be able to explain the challenges and requirements implied by the distribution aspect in the development of distributed algorithms.

Students will be able to evaluate and implement essential aspects of distributed algorithms and applications, such as causal dependency, logical time, synchronization, etc... They will be able to transfer and apply the theoretical knowledge taught in the lecture, in order to solve actual problems. In addition, students will be able to provide simple proof for the correctness of distributed algorithms.

[*updated 24.02.2018*]

Module content:
- Broadcast and propagation with feedback
- Causal dependency
- Correctness properties safety and liveness
- Models for logical time
- Scheduling
- Consistent snapshot
- Deadlock, detection and avoidance
- Mutual exclusion
- Discussion of relevant practical contributions

[*updated 20.12.2017*]

Teaching methods/Media:
Lecture slides, annotated lecture slides as a script, lecture-related practical exercises, research on current topics

[*updated 20.12.2017*]

Recommended or required reading:
A. S. TANNENBAUM, M. v. STEEN: Distributed Systems. Principles and Paradigms, CreateSpace Independent Publishing Platform, 2nd Edition, 2016

G. COULOURIS, J. DOLLIMORE, T. KINDBERG: Distributed Systems: Concepts and Design, 5th Edition, 2011

G. TEL: Introduction to distributed algorithms, Cambridge University Press; 2nd Edition, 2000

[*updated 20.12.2017*]

Embedded Systems

Module name (EN): Embedded Systems

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-EMBS

Hours per semester week / Teaching method:
2V+2P (4 hours per week)

ECTS credits:
6

Semester: 1

Mandatory course: no

Language of instruction:
German

Assessment:
Project and presentation, written exam

[*updated 24.02.2018*]

Applicability / Curricular relevance:

KI880 (P222-0082) Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 1, optional course, informatics specific
KIM-EMBS (P200-0037) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 1, optional course, informatics specific
PIM-WI25 (P610-0506) Applied Informatics, Master, ASPO 01.10.2011 , semester 1, optional course, informatics specific
PIM-EMBS (P200-0037) Applied Informatics, Master, ASPO 01.10.2017 , semester 1, optional course, informatics specific
PIM-EMBS (P200-0037) Applied Informatics, Master, SO 01.10.2026 , semester 1, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Martina Lehser

Lecturer: Prof. Dr. Martina Lehser

[*updated 10.11.2016*]

Learning outcomes:
After successfully completing this module, the students will be able to assess the special challenges involved in designing embedded systems with regard to hard and software and take them into consideration during implementation. They will be able to make necessary design decisions based on their background knowledge and develop properties with regard to real-time behavior.

[*updated 24.02.2018*]

Module content:
1. The structure of embedded systems
2. Special security requirements
3. Time behavior requirements, determinism
4. Reliability and error tolerance
5. Embedded system design
6. Real-time operating systems and job scheduling methods
7. Embedded systems project

[*updated 24.02.2018*]

Teaching methods/Media:
Lecture on the theoretical content and supervised practical course, largely independent group work within the framework of the project.

[*updated 24.02.2018*]

Recommended or required reading:
P. Marwedel: Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things, Springer 2017
G. Buttazzo: Hard Real-Time Computing Systems, Springer 2004
P. Pop et al.: Analysis and Synthesis of Distributed Real-Time Embedded Systems, Springer 2004
F. Vahid, T.Givargis: Embedded System Design, John Wiley 2003

[*updated 24.02.2018*]

Empirical Evaluation of Interactive Systems

Module name (EN): Empirical Evaluation of Interactive Systems

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-EEIS

Hours per semester week / Teaching method:
2V+2U (4 hours per week)

ECTS credits:
6

Semester: 2

Mandatory course: no

Language of instruction:
German

Assessment:

[*updated 28.02.2024*]

Applicability / Curricular relevance:

KIM-EEIS (P221-0205) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 2, optional course, telecommunications-specific
PIM-EEIS (P221-0205) Applied Informatics, Master, ASPO 01.10.2017 , semester 2, optional course, informatics specific
PIM-EEIS (P221-0205) Applied Informatics, Master, SO 01.10.2026 , semester 2, optional course, informatics specific

Suitable for exchange students (learning agreement)

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Maximilian Altmeyer

Lecturer: Prof. Dr. Maximilian Altmeyer

[*updated 26.01.2024*]

Learning outcomes:
After successfully completing this module, students will be able to empirically evaluate interactive systems, formulate research questions and hypotheses on the basis of existing scientific theories and investigate these using suitable quantitative and qualitative methods. To this end, they will be able to design and implement suitable research prototypes and study apparatus. They will be able to describe and apply basic concepts of frequentist statistics. In addition, they will be able to confidently apply suitable statistical methods to investigate specific questions, check prerequisites and take measures to prevent errors of the first and second kind. They will develop an understanding of the p-value and be able to interpret it in a reflective manner. This includes the ability to recognize the role of the p-value in statistical hypothesis tests, to understand the meaning of significance levels and to derive appropriate conclusions from the results of statistical tests. In addition, students will be able to explain and apply qualitative methods. They will be able to distinguish between qualitative and quantitative research methods, describe their respective characteristics and weigh up their applicability in different scientific contexts. In addition, they will be able to critically reflect on when a combination of both methods makes sense and how they can be used synergistically in order to achieve a comprehensive understanding of the research subject.

[*updated 28.02.2024*]

Module content:
- Introduction - Evaluation of interactive systems using the example of games
- Research questions, hypotheses

- Descriptive statistics, dealing with data
- Study equipment, research prototypes
- Ethics, informed consent
- Study design, A/B tests, Within and Between Subjects studies, counterbalancing
- Dependent & independent variables, operationalization
- Quantitative methods: t-tests, ANOVA, correlations (and non-parametric counterparts), model building
- and validation
- The P-value
- Effect measures, confidence intervals, standard deviation, outliers
- Error control
- Power analyses
- Qualitative methods: Observations, interviews, focus groups
- Qualitative methods: Coding, inter-rater reliability, theme development

In addition to the lecture part, there will be an exercise in which students develop research prototypes (e.g. adapting open-source games to a research question) and can test and apply the methods they have learned immediately.

[*updated 28.02.2024*]

Teaching methods/Media:
Interactive systems, peer review

[*updated 28.02.2024*]

Recommended or required reading:

[*updated 28.02.2024*]

Environmental Decision Support Systems

Module name (EN): Environmental Decision Support Systems

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-EDSS

Hours per semester week / Teaching method:
4V (4 hours per week)

ECTS credits:
6

Semester: 2

Mandatory course: no

Language of instruction:
German

Assessment:
Group project: requirements specification for an EDSS

[*updated 26.02.2018*]

Applicability / Curricular relevance:

KI869 Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 2, optional course, informatics specific
KIM-EDSS (P222-0106) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 2, optional course, informatics specific
MAM.2.1.2.22 (P222-0106) Engineering and Management, Master, ASPO 01.10.2013 , semester 8, optional course, informatics specific
PIM-WI65 Applied Informatics, Master, ASPO 01.10.2011 , semester 2, optional course, informatics specific
PIM-EDSS (P222-0106) Applied Informatics, Master, ASPO 01.10.2017 , semester 2, optional course, informatics specific
PIM-EDSS (P222-0106) Applied Informatics, Master, SO 01.10.2026 , semester 2, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Steven Frysinger

Lecturer: Prof. Steven Frysinger

[*updated 10.11.2016*]

Learning outcomes:
After successfully completing this module, students will be able to:
- Explain the natural and social science foundations of environmental decisions;
- Discuss the role of information systems in decision support in general, and environmental decision making in particular;
- Describe the difference between Environmental Management Information Systems and Environmental Decision Support Systems (EDSS);
- Explain the value of integrating such technologies as geographic information systems, mathematical process modeling, Monte Carlo simulation, linear programming, and expert systems into an EDSS;
- Describe the theoretical foundations of geographical information systems;
- Compare and contrast vector vs. raster encoding of spatial data layers;
- Develop a user-centered design of an EDSS for a specific decision and decision maker.

[*updated 26.02.2018*]

Module content:
Environmental Decision Support Systems are computer systems that help humans make environmental management decisions.

They facilitate "Natural Intelligence" by making information available to the human in a form that maximizes the effectiveness of their cognitive decision processes, and they can take a number of forms. EDSSs are focused on specific problems and decision-makers.

This sharp contrast with the general-purpose character of such software systems as Geographic Information Systems (GIS) is essential in order to put and keep EDSSs in the hands of real decision-makers who have neither the time nor inclination to master the operational complexities of general-purpose systems.

This course will combine seminars on various topics essential to EDSS design with a practical project in which students will specify the fundamental interaction design and software architecture of a system supporting an environmental decision problem of their choice.

[*updated 26.02.2018*]

Recommended or required reading:

[*still undocumented*]

Future Internet: Experimental Networks and Software Defined Networking

Module name (EN): Future Internet: Experimental Networks and Software Defined Networking

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-FSDN

Hours per semester week / Teaching method:
4V (4 hours per week)

ECTS credits:
5

Semester: 1

Mandatory course: no

Language of instruction:
German

Assessment:
Written exam/paper

[*updated 26.02.2018*]

Applicability / Curricular relevance:

E2933 (P222-0090) Electrical Engineering and Information Technology, Master, ASPO 01.04.2019 , optional course, technical, course inactive since 30.09.2020
KI759 (P222-0090) Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 1, optional course, informatics specific
KIM-FSDN Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 1, optional course, informatics specific
PIM-WI68 (P222-0090) Applied Informatics, Master, ASPO 01.10.2011 , semester 1, optional course, informatics specific
PIM-FSDN Applied Informatics, Master, ASPO 01.10.2017 , semester 1, optional course, informatics specific
PIM-FSDN Applied Informatics, Master, SO 01.10.2026 , semester 1, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Damian Weber

Lecturer: Prof. Dr. Damian Weber

[*updated 10.11.2016*]

Learning outcomes:
After successfully completing this course, students will be able to classify all of the consequences of adopting Software Defined Networking (SDN) to the applications development process. Students will be able to assess the impact of SDN for the TCP/IP architecture. They will also be capable of explaining and implementing openflow-based applications. In addition, students will be capable of designing control and monitoring frameworks and writing a concept for a deploying mechanism of such tools using advanced concepts such as federation.

[*updated 26.02.2018*]

Module content:
1. Networking Architectural Approaches and Issues:
- Actual IP architecture scenario and new requirements
- Software Defined Networking (SDN)
- Architectural issues: naming, addressing, mobility, scalability, autonomy and virtualization

2. OpenFlow Protocol:
- OpenFlow (OF) architecture
- OF protocol
- OF and virtualization
- OF use cases: virtual router, level 2 virtualization, other
- OF experimentation with MiniNet (hands-on exercises)

3. Experimental Networks (EN):
- Experimental Networks principles - user-defined, large and innovative experiments, users, reproducibility, scaling and monitoring:
  . Experiment (project) requirements
  . Experiment (project) planning
  . Experiment (project) execution
  . Experiment (project) monitoring
- CMF _ Control and Monitoring Framework _ model and components
- Experimental network OFELIA (OpenFlow in Europe: Linking Infrastructure and Applications) _ Architecture:
 components, tools, experimentation facilities, monitoring
- Experimental Network OMF (Orbit Management Framework) _ Architecture:
components, tools, experimentation facilities, monitoring
- Experimental Network FIBRE EU-BR (Future Internet Testbed Experimentation between Brazil and Europe) _ Architecture:
components, tools, experimentation facilities, monitoring
- Experimental networks monitoring:
- Architecture, components and issues on monitoring an experiment using an "Experimental Network" (EN)

- Study case: FIBRE EU-BR I&M Architecture
- Experimental Networks Federation:
  . Federation principles
  . SFA (Slice-based Federation Architecture) approach
- Experimental Networks "hands-on" exercise:
  Exercise: create a project/experiment on one of the above experimental networks (OFELIA, OMF or FIBRE)

4. Future Internet - Trends and Scenarios:
- QoS (Quality of Service) and QoE (Quality of Experience) in FI
- FI use cases
- FI research

[*updated 26.02.2018*]

Recommended or required reading:

[*still undocumented*]

GPU Computing

Module name (EN): GPU Computing

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-GPU

Hours per semester week / Teaching method:
2V+2P (4 hours per week)

ECTS credits:
5

Semester: 1

Mandatory course: no

Language of instruction:
German

Assessment:
Written exam/Project

[*updated 20.12.2017*]

Applicability / Curricular relevance:

KI784 (P222-0091) Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 1, optional course, informatics specific
KIM-GPU Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 1, optional course, informatics specific
PIM-WI72 (P222-0091) Applied Informatics, Master, ASPO 01.10.2011 , semester 1, optional course, informatics specific
PIM-GPU (P222-0091) Applied Informatics, Master, ASPO 01.10.2017 , semester 1, optional course, informatics specific
PIM-GPU (P222-0091) Applied Informatics, Master, SO 01.10.2026 , semester 1, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Jörg Keller

Lecturer: Prof. Dr. Jörg Keller

[*updated 10.11.2016*]

Learning outcomes:
After successfully completing this module, students will be able to understand the operation of modern CPU/GPU structures and
to compare their essential characteristics. With the help of GPU programming paradigms, they will be able to plan massively parallel approaches to solutions,
assess their resource consumption and demonstrate their practicability on the basis of concrete implementations.

Furthermore, students will be able to adapt learned techniques to new problems and assess the quality of the corresponding solutions.

[*updated 24.02.2018*]

Module content:
The lecture will start with a short overview of the architecture and
basics of parallel programming for multi-core CPUs and GPUs.
In doing so, we will concentrate on the similarities and differences,
in order to simplify the programming of GPUs by transferring parallel programs
for multi-cores. In addition to techniques such as the regularization
of control flow and memory accesses, algorithmic
techniques will also be taught using several application domains
ranging from classical numerics to cryptography.

- The architecture of modern CPU cores
  (super scalability, hyperthreading, etc.)
- The architecture of modern multi-core processors
  (multiple cores, shared caches, memory access)
- The programming of modern multi-core processors
  (basics of POSIX threads and OpenMP)
- Advanced programming of modern multi-core processors
  (examples of coordination by critical sections, barriers, etc)

- The architecture of modern GPU architectures
  (several multiprocessors, multiprocessors as SIMD architectures)
- Differences between GPUs and CPUs
  (SIMD vs MIMD, data transport, CPU/GPU collaboration)
- Advantages of GPUs over CPUs
  (processing power, explicit use of local memory, massive parallelism)
- Basics of GPU programming with CUDA
  (example programs, time measurement, relation calculation transport)
- Differences between CUDA and OpenCL
  (OpenCL more general, but more complex, code usually less efficient)

- Performance dependency between indexing and memory usage
  (differences depending on dimensional number and size, placement of variables)
- Regularization of code for performance enhancement
  (transfer of multi-core code to GPU, SIM, etc.)

- Numeric applications
  (parallel numerical solution of simple differential equations)
- Combinatorial applications
  (problems in graphs, focus on regularization)
- Cryptographic applications
  (focus on regularity, as well as bit-serial implementation)
- Hard problems
  (NP-hard problems, approximations, parallelization for GPU)

[*updated 06.09.2018*]

Teaching methods/Media:
Cuda systems with NVidia Tesla and Kepler GPU architecture

[*updated 20.12.2017*]

Recommended or required reading:

[*still undocumented*]

Human Factors

Module name (EN): Human Factors

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-HUMF

Hours per semester week / Teaching method:
4V (4 hours per week)

ECTS credits:
6

Semester: 2

Mandatory course: no

Language of instruction:
German

Assessment:
Project

[*updated 26.02.2018*]

Applicability / Curricular relevance:

KI857 Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 2, optional course, general subject
KIM-HUMF (P221-0113) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 2, optional course, general subject
MAM.2.2.6 (P221-0113) Engineering and Management, Master, ASPO 01.10.2013 , semester 8, optional course, not informatics specific
PIM-WN16 (P221-0113) Applied Informatics, Master, ASPO 01.10.2011 , semester 2, optional course, not informatics specific
PIM-HUMF (P221-0113) Applied Informatics, Master, ASPO 01.10.2017 , semester 2, optional course, not informatics specific
PIM-HUMF (P221-0113) Applied Informatics, Master, SO 01.10.2026 , semester 2, optional course, not informatics specific

Suitable for exchange students (learning agreement)

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Steven Frysinger

Lecturer: Prof. Steven Frysinger

[*updated 10.11.2016*]

Learning outcomes:
After successfully completing this module, students will be able to:
- Describe the anthropometric, ergonomic, and cognitive abilities and limitations of humans in the context of their use of such systems as automobiles, tools, workstations, and computing systems;
- Conduct critical analyses of systems with respect to the degree and effectiveness of integration with users_ characteristics;
- Identify and characterize the users of a particular product or process to be designed;
- Gather and analyze needs assessment data from representative users of a product or process;
- Develop a hierarchical task analysis of the users;
- Develop both a conceptual design and a physical design of a product or process;
- Write a user requirements specification for the system;
- Develop a test plan by which their system design could be submitted to summative evaluation upon implementation.

[*updated 26.02.2018*]

Module content:
The course content will include some (but not necessarily all) of the following topics, adjusted in part based upon the backgrounds and interests of the students:
1. Introduction to Human Factors
2. Research Methods
3. Design and Evaluation Methods
4. Visual Sensory System
5. Auditory, Tactile, and Vestibular System
6. Cognition
7. Decision Making
8. Displays
9. Controls
10. Engineering Anthropometry and Workspace Design
11. Biomechanics at Work
12. Work Physiology
13. Stress and Workload
14. Safety, Accidents, and Human Error
15. Human-Computer Interaction
16. Automation
17. Transportation Human Factors
18. Selection and Training
19. Social Factors

[*updated 26.02.2018*]

Recommended or required reading:
An Introduction to Human Factors Engineering by Christopher D. Wickens, John Lee, Yili Liu & Sallie E. Gordon-Becker (2nd edition) 2003

[*updated 26.02.2018*]

Industrial Robotics

Module name (EN): Industrial Robotics

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-IR

Hours per semester week / Teaching method:
2V+2P (4 hours per week)

ECTS credits:
5

Semester: 1

Mandatory course: no

Language of instruction:
German

Assessment:

[*updated 19.12.2023*]

Applicability / Curricular relevance:

E2845 (P221-0199) Electrical Engineering and Information Technology, Master, ASPO 01.04.2019 , semester 1, optional course
KIM-IR (P221-0199) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 1, optional course
MTM.IRO (P221-0199) Mechatronics, Master, ASPO 01.04.2020 , optional course
MP2206.IR Medical Physics, Master, ASPO 01.04.2019 , semester 1, optional course
MP2206.IR Medical Physics, Master, SO 01.10.2025 , semester 1, optional course
PIM-IR (P221-0199) Applied Informatics, Master, ASPO 01.10.2017 , semester 1, optional course
PIM-IR (P221-0199) Applied Informatics, Master, SO 01.10.2026 , semester 1, optional course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):

None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Michael Kleer

Lecturer: Prof. Dr. Michael Kleer

[*updated 24.10.2023*]

Learning outcomes:
Students will be able to identify, apply and derive the most important methods for describing and designing industrial robot systems. They will be able to independently describe, explain and calculate the interaction of industrial robot systems with various coordinate systems and the associated coordinate transformations in detail. In addition, they will be able to independently calculate the forward and inverse kinematics, as well as the velocity kinematics of typical industrial robots and solve path and trajectory planning tasks. They will be able to derive the Jacobian matrix of typical industrial robot systems and use it for further calculations.

[*updated 19.12.2023*]

Module content:
Classifying industrial robots
Rotations, transformations, coordinate system representations
Derivation of the general homogeneous transformation matrix
Derivation of the Denavit-Hartenberg transformation method
Forward and inverse kinematics of serial industrial robots
Derivation of velocity kinematics
Derivation of the Jakobi matrix (analytical & geometric Jakobi matrix)
Path and trajectory planning for industrial robots

[*updated 19.12.2023*]

Recommended or required reading:
Springer Handbook of Robotics, https://doi.org/10.1007/978-3-540-30301-5
Robot Modeling and Control, ISBN: 978-1-119-52404-5

[*updated 19.12.2023*]

Industrial UX Engineering

Module name (EN): Industrial UX Engineering

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-IUE

Hours per semester week / Teaching method:
2V+2U (4 hours per week)

ECTS credits:
6

Semester: 3

Mandatory course: no

Language of instruction:
German

Assessment:
Project work

[*updated 21.10.2024*]

Applicability / Curricular relevance:

DFI-IUE Computer Science, Master, ASPO 01.10.2018 , semester 1, optional course
KIM-IUE (P221-0207) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 3, optional course
PIM-IUE (P221-0207) Applied Informatics, Master, ASPO 01.10.2017 , semester 3, optional course
PIM-IUE (P221-0207) Applied Informatics, Master, SO 01.10.2026 , semester 3, optional course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. Pascal Stoffels

Lecturer: Prof. Dr.-Ing. Pascal Stoffels

[*updated 30.08.2024*]

Learning outcomes:
After successfully completing this module, students will be able to define personas and user stories and to identify requirements from these to support employees in production.

They will be able to design and implement assistance systems for production using various technologies.

They will be able to describe the basic principles of user experience, differentiate these from related concepts such as usability and explain the user-centered design process, while also applying this knowledge to the implementation of interactive systems in a production context.

They will be able to explain and apply prototyping concepts and discuss their advantages and disadvantages.

Students will be able to explain and apply prototyping concepts and discuss their advantages and disadvantages.

[*updated 21.10.2024*]

Module content:

Introduction to production
Worker guidance systems (pick-by-light, pick-to-light, AR...)
Component identification technology
Human-computer interaction, user experience, usability, user-centered design process
User needs, problem statements, personas, scenarios
Prototyping methods
Evaluation of interactive systems in a production environment

[*updated 21.10.2024*]

Recommended or required reading:

[*updated 21.10.2024*]

IT & Production

Module name (EN): IT & Production

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-IUP

Hours per semester week / Teaching method:
2V+2U (4 hours per week)

ECTS credits:
6

Semester: 2

Mandatory course: no

Language of instruction:
English

Assessment:
Project: written composition and presentation

[*updated 05.11.2025*]

Applicability / Curricular relevance:

KIM-IUP (P221-0206) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 2, optional course, telecommunications-specific
PIM-IUP (P221-0206) Applied Informatics, Master, ASPO 01.10.2017 , semester 2, optional course, informatics specific

PIM-IUP (P221-0206) Applied Informatics, Master, SO 01.10.2026 , semester 2, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. Pascal Stoffels

Lecturer: Prof. Dr.-Ing. Pascal Stoffels

[*updated 17.01.2024*]

Learning outcomes:
After successfully completing this module, students will be able to classify selected problems in production and identify corresponding starting points.

They will be able to develop solutions for industrial problems.

They will be able to plan the individual phases of a project, define milestones, monitor progress, and evaluate and summarize the results.

[*updated 08.08.2024*]

Module content:
- IT infrastructure/architecture in factories
- Industrial communication
- Industrial ethernet
- M2M communication (OPC, MQTT, Apache Kafka)
- Monitoring machines/data analytics/AI
- Project management

[*updated 05.11.2025*]

Teaching methods/Media:
Students will work on a software solution for selected production problems.

[*updated 08.08.2024*]

Recommended or required reading:
Thomas Stober, Uwe Hansmann: Agile Software Development; Springer-Verlag Berlin Heidelberg 2010
Jürgen Kletti (Hrsg.): MES Manufacturing Execution System; Springer-Verlag Berlin Heidelberg 2015
Jürgen Kletti: Konzeption und Einführung von MES-Systemen; Springer-Verlag Berlin Heidelberg 2007
Manfred Bornewasser, Sven Hinrichsen (Hrsg.): Informatorische Assistenzsysteme in der variantenreichen Montage; Springer-Verlag GmbH Deutschland, ein Teil von Springer Nature 2020
Alexander Sinsel: Das Internet der Dinge in der Produktion; Springer-Verlag GmbH Deutschland, ein Teil von Springer Nature 2020
Johannes Pistorius: Industrie 4.0 Schlüsseltechnologien für die Produktion; Springer-Verlag GmbH Deutschland, ein Teil von Springer Nature 2020

[*updated 08.08.2024*]

IT and TC Law

Module name (EN): IT and TC Law

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-ITR

Hours per semester week / Teaching method:
2V (2 hours per week)

ECTS credits:
3

Semester: 2

Mandatory course: no

Language of instruction:
German

Assessment:
Written exam 120 min.

[*updated 26.02.2018*]

Applicability / Curricular relevance:

FTM-ITR Automotive Engineering, Master, ASPO 01.04.2021 , semester 1, optional course
FTM-ITR Automotive Engineering, Master, ASPO 01.04.2023 , semester 1, optional course
KIM-ITR (P222-0056) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 2, mandatory course
PIM-ITR (P222-0056) Applied Informatics, Master, ASPO 01.10.2017 , semester 2, optional course, not informatics specific
PIM-ITR (P222-0056) Applied Informatics, Master, SO 01.10.2026 , semester 2, optional course, not informatics specific

Workload:

30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 90 hours (equivalent to 3 ECTS credits).
There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Studienleitung

Lecturer: Studienleitung

[*updated 27.09.2016*]

Learning outcomes:
Students will be able to apply essential legal terms and legal norms in day-to-day IT/telecommunications work. In addition to general content such as copyright and trademark law, contract law, data and customer protection ordinances, this includes IT/TC-specific content such as telecommunications law, software law and Internet law.

Students will be capable of analyzing the interrelationships and applicability of the various regulations and laws in the field of information technology and using examples be able to apply them to typical situations.

[*updated 26.02.2018*]

Module content:
1. Domain law
2. Copyright law
3. Open source software
4. Trademark law
5. Impressum (Imprint (UK), Site notice (USA))
6. Contract law: concluding a contract on the Internet
7. GTC law
8. Project agreement
9. Written form, electronic signature, responsibility
10. Distance selling, right of withdrawal
11. Data protection
12. Advertising
13. Telecommunications law
14. Product liability

One method of teaching the legal topics will be to use the classic example of a website with an online shop.

[*updated 26.02.2018*]

Recommended or required reading:
http://bundesrecht.juris.de/aktuell.html
(Gesetzestexte, BGB)

http://www.jurawelt.de/

see "Studentenwelt" (Skripte, Zivilrecht)

http://www.uni-muenster.de/Jura.itm/hoeren/
see "Lehre", "Materialien", Skriptum Internet-Recht

[*updated 26.02.2018*]

Modeling Languages and Communication Systems

Module name (EN): Modeling Languages and Communication Systems

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-MOD

Hours per semester week / Teaching method:
2V+2U (4 hours per week)

ECTS credits:
6

Semester: 1

Mandatory course: no

Language of instruction:
German

Assessment:
Written exam, Duration 90 min.

[*updated 13.11.2024*]

Applicability / Curricular relevance:

KIM-MOD (P222-0060) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 1, mandatory course
PIM-MOD (P222-0060) Applied Informatics, Master, ASPO 01.10.2017 , semester 1, optional course, informatics specific
PIM-MOD (P222-0060) Applied Informatics, Master, SO 01.10.2026 , semester 1, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Reinhard Brocks

Lecturer: Prof. Dr. Reinhard Brocks

[*updated 27.09.2016*]

Learning outcomes:
After After successfully completing this module, students will be able to develop communication protocols with serialization libraries. They will be able to specify message sequences in the form of a UML sequence diagram. They will be able to describe and design system component behavior using UML state diagrams. Students will be able to explain the generic functioning of test frameworks. They will be able to explain the principles of automated browser tests, design user tests and implement and execute these with a framework in the IDE and with a build tool. They will be able to explain the principles of model-driven software development.

[*updated 13.11.2024*]

Module content:
- Serialization
- Specification / modeling message flows
- Behavioral specification of communication instances, state-based design
- Testing web applications and communication systems
- Model-driven software development and domain-specific languages

[*updated 13.11.2024*]

Teaching methods/Media:
Some problem-based learning, practical training and exercises

[*updated 20.12.2017*]

Recommended or required reading:
- Specialist literature
  + Dubuisson, Olivier: ASN.1, Communication between heterogeneous Systems, Morgan Kaufmann, 2001, ISBN 0-12-633361-0, http://asn1.elibel.tm.fr/en/book/
- Specifications
  + ITU-T Recommendation: Z series: Languages and general software aspects for telecommunication systems
    # Z.120: Message Sequence Chart (MSC), 02/2011
    # Z.161: Testing and Test Control Notation version 3: TTCN-3 core language, 10/2023
    # Z.163: Testing and Test Control Notation version 3: TTCN-3 graphical presentation format (GFT), 11/2007
    # Z.150: User Requirements Notation (URN) - Language requirements and Framework, 02/2011
  + ITU-T Recommendation: X series: Data networks, open system communications and security
    # X.680: Information technology - Abstract Syntax Notation One (ASN.1): Specification of basic notation, 11/2008
- Object Management Group / OMG
  + Systems Modeling Language 1.6, 01/2019
  + Unified Modeling Language, 2.5.1, 12/2017

[*updated 13.11.2024*]

Planning and Running IT Workshops

Module name (EN): Planning and Running IT Workshops

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-PDIW

Hours per semester week / Teaching method:
1V+1P (2 hours per week)

ECTS credits:
3

Semester: 1

Mandatory course: no

Language of instruction:
German

Assessment:
Project work

[*updated 26.02.2018*]

Applicability / Curricular relevance:

KI762 Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 1, optional course, informatics specific
KIM-PDIW (P221-0200) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 1, optional course, informatics specific
PIM-WI48 Applied Informatics, Master, ASPO 01.10.2011 , semester 1, optional course, informatics specific
PIM-PDIW (P221-0200) Applied Informatics, Master, ASPO 01.10.2017 , semester 1, optional course, informatics specific
PIM-PDIW (P221-0200) Applied Informatics, Master, SO 01.10.2026 , semester 1, optional course, informatics specific

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 90 hours (equivalent to 3 ECTS credits).
There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. André Miede

Lecturer: Prof. Dr.-Ing. André Miede

[*updated 10.11.2016*]

Learning outcomes:
After successfully completing this course, students will be able to describe, explain and compare the special challenges involved in planning, organizing and carrying out technical workshops. They will be able to use what they have learned to develop and carry out courses themselves, e. g. for the development of computer games or for the construction and programming of robots.

[*updated 26.02.2018*]

Module content:
* Create a concept for a course
* Develop and create course materials in German
* Plan, organize and conduct a course for a selected target group
* Review and document the experiences made

In addition to the topics mentioned above, this course will also focus on specialized and technical questions pertaining to workshops.

In addition to this course, we recommend students take part in the elective "Planung und Durchführung technischer Workshops" ("Planning and Running Technical Workshops"). It focuses in the didactic aspects in the planning, implementation and evaluation of workshops. The order in which the two courses are taken is arbitrary (the courses have different thematic focuses, but they both accompany a complete workshop life cycle).

[*updated 26.02.2018*]

Recommended or required reading:
Literature and external support will be provided for the implementation and moderation of workshops.

[*updated 26.02.2018*]

Planning and Running RoboNight Workshops

Module name (EN): Planning and Running RoboNight Workshops

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-PDRW

Hours per semester week / Teaching method:
1PA+1S (2 hours per week)

ECTS credits:
3

Semester: 2

Mandatory course: no

Language of instruction:
German

Assessment:
Participation in 5 classes, 3 workshops, the competition + a written composition

[*updated 24.02.2018*]

Applicability / Curricular relevance:

KI863 Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 2, optional course, general subject
KIM-PDRW (P222-0092) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 2, optional course, general subject
MTM.PRN Mechatronics, Master, ASPO 01.04.2020 , optional course, not informatics specific
MAM.2.1.1.10 (P222-0092) Engineering and Management, Master, ASPO 01.10.2013 , semester 8, optional course, not informatics specific
MST.PRN Mechatronics and Sensor Technology, Master, ASPO 01.04.2016 , optional course, not informatics specific
PIM-WN21 (P221-0166) Applied Informatics, Master, ASPO 01.10.2011 , semester 2, optional course, not informatics specific
PIM-PDRW (P222-0092) Applied Informatics, Master, ASPO 01.10.2017 , semester 2, optional course, not informatics specific
PIM-PDRW (P222-0092) Applied Informatics, Master, SO 01.10.2026 , semester 2, optional course, not informatics specific
MST.PRN Mechatronics and Sensor Technology, Master, ASPO 01.10.2011 , optional course, not informatics specific

Suitable for exchange students (learning agreement)

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 90 hours (equivalent to 3 ECTS credits).
There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Steffen Knapp

Lecturer: Prof. Dr. Steffen Knapp

[*updated 10.11.2016*]

Learning outcomes:
After successfully completing this module, the students will be able to assess the special challenges involved in conducting technical
workshops and take them into regard during the preparatory phase of the workshop. They will be able to adapt the contents of the training courses to the participants´ previous knowledge and provide appropriate support in dealing with technical questions. Students will also be able to collect and prepare the knowledge necessary for the course and impart it to the workshop participants in such a manner as to fit their age

groups.

In addition, they will be able to put together tasks that are specifically adapted to their target groups and will help build and consolidate their workshop participants´ knowledge in the programming and construction of robots. They will know the technical possibilities and limitations of the systems used and will be able to estimate the logistical work involved in preparing the workshop.

[*updated 24.02.2018*]

Module content:
- Conceive and formulate tasks (for workshops and competition)
- Design and implement possible solutions
- Create training materials and video tutorials
- Conduct intensive courses for small groups
- Organize and conduct 3 workshops
- Organize and supervise the competition
- Conduct follow-up work and document the experiences made

[*updated 24.02.2018*]

Teaching methods/Media:
Introductory workshop for robot programming with Mindstorm robots on computers and tablets, supervised practical course, largely independent development of the contents in groups, project discussions and workshop coaching.

[*updated 24.02.2018*]

Recommended or required reading:
- EV3-Programmierung Kurse, htw saar, EmRoLab 2017
- Programming LEGO NXT Robots using NXC, Daniele Benedettelli
- Workbook Bluetooth, HTWdS, EmRoLab 2011
- NXT-Programmierung I und II: Einführung und Fortgeschrittene, HTWdS, EmRoLab 2011

[*updated 24.02.2018*]

Planning and Running Technical Workshops

Module name (EN): Planning and Running Technical Workshops

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-PDTW

Hours per semester week / Teaching method:
1V+1P (2 hours per week)

ECTS credits:
3

Semester: 2

Mandatory course: no

Language of instruction:
German

Assessment:
Workshop, written composition and presentation

[*updated 26.02.2018*]

Applicability / Curricular relevance:

KI836 Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 2, optional course, general subject
KIM-PDTW (P221-0187) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 2, optional course, general subject
PIM-WN13 Applied Informatics, Master, ASPO 01.10.2011 , semester 2, optional course, not informatics specific
PIM-PDTW (P221-0187) Applied Informatics, Master, ASPO 01.10.2017 , semester 2, optional course, not informatics specific
PIM-PDTW (P221-0187) Applied Informatics, Master, SO 01.10.2026 , semester 2, optional course, not informatics specific

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 90 hours (equivalent to 3 ECTS credits).
There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. André Miede

Lecturer: Prof. Dr.-Ing. André Miede

[*updated 10.11.2016*]

Learning outcomes:
After successfully completing this course, students will be able to describe, explain and compare the special challenges involved in planning, organizing and carrying out technical workshops. They will be able to use what they have learned to develop and carry out courses themselves, e. g. for the development of computer games or for the construction and programming of robots.

[*updated 26.02.2018*]

Module content:
* Create a concept for a course
* Develop and create course materials in German
* Plan, organize and conduct a course for a selected target group
* Review and document the experiences made

In addition to the topics mentioned above, this course will also focus on specialized and technical questions pertaining to workshops.

In addition to this course, we recommend students take part in the elective "Planung und Durchführung von IT-Workshops" ("Planning and Running IT Workshops"). It focuses on the specialized, technical aspects of workshops. The order in which the two courses are taken is arbitrary (the courses have different thematic focuses, but they both accompany a complete workshop life cycle).

[*updated 26.02.2018*]

Recommended or required reading:
* Werner Hartmann, Michael Näf, Raimond Reichert: Informatikunterricht planen und durchführen. Springer. http://link.springer.com/book/10.1007/978-3-540-34485-8

* Peter Hubwieser: Didaktik der Informatik -- Grundlagen, Konzepte, Beispiele. Springer. http://link.springer.com/book/10.1007/978-3-540-72478-0

[*updated 26.02.2018*]

Quantum Computing

Module name (EN): Quantum Computing

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-QC

Hours per semester week / Teaching method:
2V+2P (4 hours per week)

ECTS credits:
5

Semester: 1

Mandatory course: no

Language of instruction:
German

Assessment:

[*updated 23.09.2025*]

Applicability / Curricular relevance:

KIM-QC (P221-0216) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 1, optional course

PIM-QC (P221-0216) Applied Informatics, Master, ASPO 01.10.2017 , semester 1, optional course
PIM-QC (P221-0216) Applied Informatics, Master, SO 01.10.2026 , semester 1, optional course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Dipl.-Physiker Michael Meßner

Lecturer: Dipl.-Physiker Michael Meßner

[*updated 24.06.2025*]

Learning outcomes:
After successfully completing this module, students will be familiar with the physical principles of quantum computing.
They will be familiar with the differences between quantum computers and classical computers.
They will know what a quantum bit is and understand how it is represented mathematically.
They will be able to visualize a quantum bit in the Bloch sphere.
Students will be able to perform transformations on qubits.
They will be able to visualize a transformation in the Bloch sphere.
They will be familiar with the properties of transformations.
They will know that transformations are implemented using gates.
Students will be able to handle multiple quantum bits in a quantum register.
They will be able to perform transformations on a quantum register.
They will be familiar with the Quantum Composer and know how to program it.
They will understand the visualization of the quantum bit state.
Students will be aware of the importance of measurement in quantum computing.
They will be familiar with the basic algorithms for quantum gate computers.
They will understand the necessity of error correction algorithms for qubits.
Students will be able to build circuits for quantum gate computers.
They will be able to analyze circuits mathematically.
They will be familiar with the mathematical framework for handling qubits and transformations.
They will be able to simulate a quantum circuit using the Quantum Composer.
They will be able to operate the Quantum Composer.
Students will be able to run a quantum circuit on an IBM quantum computer.
They will be able to create a simple program with Qiskit and run it on a quantum computer.
Students will be familiar with several algorithms.
They will be able to apply error correction algorithms.

[*updated 23.09.2025*]

Module content:
1. Introduction
2. Physics
3. Classic computer

4. Quantum bit
5. Quantum gate/transformation
6. Quantum register
7. Quantum register gate/transformation
8. IBM Quantum Composer
9. Basics
10. IBM Quantum Platform
11. Entanglement
12. Algorithms
13. Measurement
14. Error correction

[*updated 23.09.2025*]

Recommended or required reading:
Quanten Computing, Vorlesung Winter 2020/2021, Jochen Rau, Goethe Universität Frankfurt(Main)
Quantentechnologien, Vorlesung Winter 2020/2021, Jochen Rau, Goethe Universität Frankfurt(Main)
Quantum Computing verstehen, Matthias Homeister, Springer Vieweg, 6. Auflage, 2022

[*updated 23.09.2025*]

Research and Innovation Management

Module name (EN): Research and Innovation Management

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-FUIM

Hours per semester week / Teaching method:
4SU (4 hours per week)

ECTS credits:
6

Semester: 2

Mandatory course: no

Language of instruction:
German

Assessment:
Project, talk

[*updated 24.02.2018*]

Applicability / Curricular relevance:

E2844 (P200-0035) Electrical Engineering and Information Technology, Master, ASPO 01.04.2019 , optional course, general subject

E1845 Electrical Engineering, Master, ASPO 01.10.2013 , optional course, non-technical
KI832 Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 2, optional course, non-technical
KIM-FUIM (P200-0035) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 2, optional course, non-technical
MTM.FIM (P200-0035) Mechatronics, Master, ASPO 01.04.2020 , optional course, non-technical
MAM.2.2.19 (P200-0035) Engineering and Management, Master, ASPO 01.10.2013 , semester 2, optional course, non-technical
PIM-WN43 Applied Informatics, Master, ASPO 01.10.2011 , semester 2, optional course, not informatics specific
PIM-FUIM (P200-0035) Applied Informatics, Master, ASPO 01.10.2017 , semester 2, optional course, not informatics specific
PIM-FUIM (P200-0035) Applied Informatics, Master, SO 01.10.2026 , semester 2, optional course, not informatics specific
MST.FIM Mechatronics and Sensor Technology, Master, ASPO 01.10.2011 , optional course, non-technical

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. John Heppe

Lecturer: Prof. Dr.-Ing. John Heppe

[*updated 10.11.2016*]

Learning outcomes:
After successfully completing this module, students will be able to
develop innovative ideas in a team using creative methods and to define a new product,
quantify its degree of innovation and differentiate it from the current state of the art or direct competitors,
select a product-specific development and production environment,
divide the work required to turn the idea into a marketable product into work packages, estimate the time and cost involved and identify financing options and
present their idea, its feasibility and the market opportunities in a joint presentation in a well-founded and convincing manner.

[*updated 24.02.2018*]

Module content:
- Definition and concept of the term innovation and the innovation process
- Methods for finding new ideas
- From the project idea to project management
- Marketing I: developing strategic options
- Marketing II: advertising, price, product features
- Introduction to knowledge management

_ Intellectual capital as a management tool
_ State of the art, including property and patent rights
_ "Open innovation" strategic approach
_ Becoming an innovative company through organizational development

[*updated 24.02.2018*]

Teaching methods/Media:
_ Workshops
_ Group work

[*updated 20.12.2017*]

Recommended or required reading:
_ Walter Jakoby: _Projektmanagement für Ingenieure_, Springer Vieweg (2012)
_ Lothar Haberstock: _Kostenrechnung I_, Erich Schmidt Verlag

[*updated 24.02.2018*]

Service Management with ITIL

Module name (EN): Service Management with ITIL

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-ITIL

Hours per semester week / Teaching method:
2V (2 hours per week)

ECTS credits:
3

Semester: 2

Mandatory course: no

Language of instruction:
German

Assessment:
Written or oral exam

[*updated 20.12.2017*]

Applicability / Curricular relevance:

KI874 (P222-0081) Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 2, optional course, general subject
KIM-ITIL (P222-0081) Computer Science and Communication Systems, Master, ASPO 01.10.2017 ,

semester 2, optional course, general subject
MAM.2.2.17 (P222-0081) Engineering and Management, Master, ASPO 01.10.2013 , semester 8, optional course, general subject
MST.SMI Mechatronics and Sensor Technology, Master, ASPO 01.04.2016 , optional course, general subject, course inactive since 27.10.2015
PIM-WN31 Applied Informatics, Master, ASPO 01.10.2011 , semester 2, optional course, not informatics specific
PIM-ITIL (P222-0081) Applied Informatics, Master, ASPO 01.10.2017 , semester 2, optional course, not informatics specific
PIM-ITIL (P222-0081) Applied Informatics, Master, SO 01.10.2026 , semester 2, optional course, not informatics specific
MST.SMI Mechatronics and Sensor Technology, Master, ASPO 01.10.2011 , optional course, general subject

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 90 hours (equivalent to 3 ECTS credits).
There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. André Miede

Lecturer: Prof. Dr.-Ing. André Miede

[*updated 10.11.2016*]

Learning outcomes:
Students will know and be able to explain the practice-proven procedures for the successful provision of IT services, including the necessary definitions of terms according to the international framework ITIL. They can differentiate between processes, their goals, roles and functions in the Service Life Cycle.

[*updated 20.12.2017*]

Module content:
1. IT Service Management according to ITIL
Welcome to ITIL 4. A new era in IT development has begun. ITIL 4´s holistic approach sharpens service management´s profile in organizations and industries by giving it a strategic context.
The focus is placed on a value chain of products and services.

2. Key concepts of service management
A common understanding of the central concepts and terms of ITIL within organizations and among individuals is an essential prerequisite for the effective use of these best practices in mastering real-world service management challenges.

3. The four dimensions of service management
In order to achieve the desired results and work as effectively as possible, organizations must consider all aspects of their behavior. There are several aspects to consider in service management. None of them is enough on its own to achieve the required results. To support the holistic approach, ITIL defines the

dimensions.

4. The ITIL Service Value System (SVS)
For service management to work well, it must function as a complete system. The ITIL SVS describes the inputs for this system, the elements and outputs, and how they interact to enable value creation.

5. IT management practices
ITIL SVS comprises 14 general management practices, 17 service management practices, and three technical management practices, all of which fall under the four dimensions of service management.
In ITIL, a management practice is a group of organizational resources designed to perform tasks or achieve a goal.

The module takes place as a block seminar on several Saturdays. There will be a kick-off event at the beginning of the semester. For more information, please see further bulletins.

In addition to the written exam, students will have the chance to become certified via an external exam (ITIL Foundation). More information will be available in the lecture.

[*updated 05.06.2025*]

Teaching methods/Media:
Case studies, practice test, coaching

[*updated 20.12.2017*]

Recommended or required reading:
Official ITIL page: https://www.axelos.com/certifications/itil-service-management
itSMF Deutschland e.V. https://www.itsmf.de/

[*updated 05.06.2025*]

Shape Analysis

Module name (EN): Shape Analysis

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-SHAN

Hours per semester week / Teaching method:
2V+2P (4 hours per week)

ECTS credits:
6

Semester: 2

Mandatory course: no

Language of instruction:
German

Assessment:
Project (presentation and documentation)

[*updated 26.02.2018*]

Applicability / Curricular relevance:

KI844 (P221-0143) Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 2, optional course, informatics specific
KIM-SHAN (P222-0126) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 2, optional course, informatics specific
PIM-WI52 (P221-0143) Applied Informatics, Master, ASPO 01.10.2011 , semester 2, optional course, informatics specific
PIM-SHAN Applied Informatics, Master, ASPO 01.10.2017 , semester 2, optional course, informatics specific
PIM-SHAN Applied Informatics, Master, SO 01.10.2026 , semester 2, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Dr.-Ing. Jörg Herter

Lecturer: Dr.-Ing. Jörg Herter

[*updated 10.11.2016*]

Learning outcomes:
After successfully completing this course, students will have intensified their theoretical and practical knowledge about
static program analysis techniques.
They will have an overview of different shape analysis approaches,
can differentiate between the different approaches and can
describe the analysis by means of 3-valued logic.
Students will be able to independently understand sample analyses from scientific publications, reproduce their results
and adapt solutions from these analyses for their own
analyses.
Students will be able to plan and carry out analyses independently within a group
by means of 3-valued logic and to document the resulting results.

[*updated 26.02.2018*]

Module content:
Shape analyses are highly comprehensive program analyses that attempt to calculate all possible (heap) memory states (which objects are created, how these objects are connected to each other [field pointers] and how they are used), which a program can achieve using the program code. An attempt is then made to derive what the program does, whether it might contain errors, and so on from this set of program states.
Unlike typical program analyses that compilers perform to detect optimization possibilities, shape analyses can for example, be used to automatically check whether a program is working correctly.

Course content:
1. Introduction/Motivation
2. Kleene´s 3-valued logic
3. Shape analysis with 3-valued logic
4. Introduction into TVLA (Three Valued Logical Analyzer)
5. Case studies and example analyses with TVLA

[*updated 26.02.2018*]

Recommended or required reading:
Mooly Sagiv, Thomas Reps und Reinhard Wilhelm:
Parametric Shape Analysis via 3-Valued Logic
ACM Transactions on Programming Languages and Systems, 2002.

Jan Reineke:
Shape Analysis of Sets.
Masterarbeit an der Universität des Saarlandes, 2005.

Tal Lev-Ami, Thomas W. Reps, Mooly Sagiv und Reinhard Wilhelm:
Putting static analysis to work for verification: A case study.
ISSTA 2000: 26-38.

Tal Lev-Ami und Mooly Sagiv:
TVLA: A System for Implementing Static Analyses.
SAS 2000: 280-301.

Tal Lev-Ami:
TVLA: A framework for Kleene based static analysis.
Masterarbeit an der Universität Tel-Aviv, Israel, 2000.

[*updated 26.02.2018*]

Simulation and Hardware Implementation of Digital Algorithms and Systems

Module name (EN): Simulation and Hardware Implementation of Digital Algorithms and Systems

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-DALG

Hours per semester week / Teaching method:
2V+2P (4 hours per week)

ECTS credits:

5

Semester: 1

Mandatory course: no

Language of instruction:
German

Assessment:
Project, oral examination

[*updated 20.12.2017*]

Applicability / Curricular relevance:

KI843 Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 1, optional course, telecommunications-specific
KIM-DALG (P222-0109) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 1, optional course, telecommunications-specific
PIM-WI76 Applied Informatics, Master, ASPO 01.10.2011 , semester 1, optional course, informatics specific
PIM-DALG (P222-0109) Applied Informatics, Master, ASPO 01.10.2017 , semester 1, optional course, informatics specific
PIM-DALG (P222-0109) Applied Informatics, Master, SO 01.10.2026 , semester 1, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Martin Buchholz

Lecturer: Prof. Dr. Martin Buchholz

[*updated 10.11.2016*]

Learning outcomes:
After successful completion of this module, students will understand the complex algorithms of telecommunications engineering. They will be capable of optimizing a digital system, because they know the limiting conditions of optimal software/hardware partitioning. Students will be able to estimate the effort required to implement this system and select the suitable technology (digital signal processors, microcontrollers or a hardware-based solution).

Students can use the process flow to implement these systems in DSP and FPGA and are familiar with the most common EDA tools.

Students can verify the successful implementation of the algorithms in metrological terms and record and evaluate them quantitatively.

[*updated 20.12.2017*]

Module content:
1.Complex digital algorithms in telecommunications engineering
Digital modulators und demodulators
Source and channel coding and decoding
Digital audio and video signal processing
Error protection methods
Synchronization methods
2.Software Defined Radio architectures
3.Hardware-Software partioning
4.Simulation with EDA tools such as Simulink, SPW (Signal Processor Workstation) and ML Designer, Co-simulation
5.Fundamentals of Digital Signal Processors (DSP)
6.Introduction to programmable hardware (FPGA)
7.Computer-aided, real-time implementation in digital signal processors (DSP) and programmable hardware (FPGA)
8.Synthesis, place and route, back annotation and debugging
9.Digitale measurement technology

[*updated 24.02.2018*]

Teaching methods/Media:
Lecture notes, projector, EDA simulation tools, lab work

[*updated 20.12.2017*]

Recommended or required reading:
Oppenheim, A. V.; Schafer, R. W.: Zeitdiskrete Signalverarbeitung, Oldenbourg Verlag, 1999
Proakis, J.G.: Digital Communications, Mc Graw Hill, 2000
Stearns, S.D.; Hush D.R.: Digitale Vararbeitung analoger Signale, Oldenbourg, 1999
Von Grünigen, D. Ch.: Digitale Signalverarbeitung, Carl-Hanser Verlag, 2004
Kammeyer, K.-D. / Kroschel K.: Digitale Signalverarbeitung - Filterung und Spektralanalyse, Teubner
Haykin, S.: Digital Communication Systems, John Wiley and Sons, 200
Abut, H. ; Hansen, J. ; Takeda, K.: DSP for IN-Vehicle and Mobile Systems, Springer, 2005
Bateman, A.; Paterson-Stephens, I.: The DSP Handbook, Algorithms, Applications and Design Techniques, Prentice Hall, 2002
Wolf, W.: FPGA Based System Design, Prentice Hall, 2004

[*updated 24.02.2018*]

Sino-German Smart Sensor Project

Module name (EN): Sino-German Smart Sensor Project

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-SGSP

Hours per semester week / Teaching method:
4PA (4 hours per week)

ECTS credits:
6

Semester: 1

Mandatory course: no

Language of instruction:
German

Assessment:
Project

[*updated 20.12.2017*]

Applicability / Curricular relevance:

KI785 Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 1, optional course, informatics specific
KIM-SGSP Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 1, optional course, informatics specific
PIM-WI73 (P221-0161) Applied Informatics, Master, ASPO 01.10.2011 , semester 1, optional course, informatics specific
PIM-SGSP Applied Informatics, Master, ASPO 01.10.2017 , semester 1, optional course, informatics specific
PIM-SGSP Applied Informatics, Master, SO 01.10.2026 , semester 1, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Martina Lehser

Lecturer: Prof. Dr. Martina Lehser

[*updated 26.06.2017*]

Learning outcomes:
After successfully completing this module, students will be able to design and develop Smart Services based on Industry 4.0 or the Internet of Things in an international and globally distributed project team.

In addition to acquiring professional qualifications in a project team with different linguistic, social and geographical environments, students will:

- learn to assume professional and organizational responsibility
- receive insights into intercultural competence with a focus on China
- be capable of communicating in and with the foreign language environment
- be able to arrange work with team members from different learning backgrounds and nations
- establish contacts with foreign partners promoting internationalization
- analyze and where necessary, adapt to other work methods

All of the above will enable students to quickly enter international project management after starting their career.

[*updated 24.02.2018*]

Module content:
Students from various fields and levels of study and with different degrees from the htw saar and CDHAW (Tongji Univ., Shanghai) will form a globally distributed team. The team will consist of 5 to 15 students. Over the period of a full semester, the team will work on a specific task within the project.
At the team s locations, different aspects will be dealt with. At the htw saar the topic will be software development and at the CDHAW the topics will be hardware and production.

The project results will be presented to the lecturers in the form of a presentation and a final report.

Project management:
- Specifications
- Project planning
- Version management

Software development:
- Embedded devices
- Data logging
- Machine-to-machine communication
- Protocols (MQTT, OPC UA, AMQP)

Interfaces:
- Generic interfaces as Smart Services
- Integration of Smart Services
- Communication between Smart Services
- Gradual aggregation of Smart Services

Intercultural competence:
- Focus: China
- Patterns of communication
- Work methods
- The concept of time

[*updated 14.05.2025*]

Teaching methods/Media:
Lecture, workshop, training
Online/offline meetings

[*updated 20.12.2017*]

Recommended or required reading:
- China-Strategie des BMBF 2015 2020: Strategischer Rahmen für die Zusammenarbeit mit China in Forschung, Wissenschaft und Bildung

- Umsetzungsempfehlungen für das Zukunftsprojekt Industrie 4.0: Abschlussbericht des Arbeitskreises Industrie 4.0
- Konflikte und Synergien in multikulturellen Teams, Petra Köppel
- Management von IT-Projekten, Dr. Hans W. Wieczorrek, Dipl.-Math. Peter Mertens
- Führung im Projekt, Dr. Thomas Bohinc
- Embedded Technologies, Joachim Wietzke
- Embedded Linux, Joachim Schröder · Tilo Gockel · Rüdiger Dillmann

[*updated 14.05.2025*]

Software Development for Communication Systems

Module name (EN): Software Development for Communication Systems

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-SWKS

Hours per semester week / Teaching method:
2V+2P (4 hours per week)

ECTS credits:
6

Semester: 2

Mandatory course: no

Language of instruction:
German

Assessment:
Project work

[*updated 13.11.2024*]

Applicability / Curricular relevance:

DFI-SWKS Computer Science, Master, ASPO 01.10.2018 , semester 2, optional course
KIM-SWKS (P222-0070) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 2, mandatory course
PIM-SWKS (P221-0191, P222-0070) Applied Informatics, Master, ASPO 01.10.2017 , semester 2, optional course, informatics specific
PIM-SWKS (P221-0191, P222-0070) Applied Informatics, Master, SO 01.10.2026 , semester 2, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):

None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Reinhard Brocks

Lecturer: Prof. Dr. Reinhard Brocks

[*updated 13.03.2019*]

Learning outcomes:
After successfully completing this module, students will be able to complete a project in the area of communication systems, even with unfamiliar software frameworks and development tools, in order to quickly familiarize themselves with a complex project in the company.

[*updated 13.11.2024*]

Module content:
Students will carry out a software project on a topic from the field of communication networks. As a rule, it should cover all aspects of the development process, from build management, requirement engineering, software design and implementation to testing and deployment. The project must be documented and will end with a presentation by the student.

Possible technical aspects:
* Serialization Codec implementation based on various serialization techniques (ASN.1, JSON, XML, Protobuf)
* Test automation: Unit testing, browser testing, performance measurements, load and stress testing
* Communication: REST, GraphQL, interprocess communication, client-server programming based on different transmission protocols (UDP, TCP, HTTP, MQTT), encrypted network connections, streaming
* Model-driven software development, domain-specific languages
* Single-board computers
* Network simulation
* Implementation techniques of protocol layers and state machines
* Threads / Parallel programming
* Timer
* Tracing / Logging / Monitoring
* Platform configurations, server management

[*updated 19.05.2023*]

Teaching methods/Media:
In progress...

[*updated 30.06.2025*]

Recommended or required reading:
Class literature will be based on the project s context. This usually consists of online sources on the frameworks used, software development tools or textbook literature on design methods.

[*updated 19.05.2023*]

Software Quality Engineering

Module name (EN): Software Quality Engineering

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-SQE

Hours per semester week / Teaching method:
2V+2PA (4 hours per week)

ECTS credits:
6

Semester: 1

Mandatory course: no

Language of instruction:
German

Assessment:
Project with final presentation

[*updated 20.12.2017*]

Applicability / Curricular relevance:

DFI-SQE Computer Science, Master, ASPO 01.10.2018 , semester 1, optional course, informatics specific
KI786 Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 1, optional course, informatics specific
KIM-SQE (P221-0144) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 1, optional course, informatics specific
PIM-WI78 Applied Informatics, Master, ASPO 01.10.2011 , semester 1, optional course, informatics specific
PIM-SQE (P221-0144) Applied Informatics, Master, ASPO 01.10.2017 , semester 1, optional course, informatics specific
PIM-SQE (P221-0144) Applied Informatics, Master, SO 01.10.2026 , semester 1, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. Martin Burger

Lecturer: Prof. Dr.-Ing. Martin Burger

[*updated 04.07.2017*]

Learning outcomes:
In times of large IT projects on the one hand and agile software development (with shorter and shorter release cycles) on the other, the importance of software quality assurance increases.
_ After successfully completing this course, students will be able to define the most important terms and concepts in software quality engineering and explain them using examples.
_ They will know and understand the various concepts of static and dynamic test techniques and be able to apply them to actual problems.
_ Students will be able to differentiate between different types of tests and know how they are used in different test stages and how to integrate them into the test process.
_ Students will become familiar with the different requirements for quality assurance in classic and agile development models and how these can be met.
_ Students will understand how to use tools for support in different scenarios and types of tests (test organization, test automation, load and performance tests, etc.)

[*updated 24.02.2018*]

Module content:
1. Basics of software quality assurance and introduction to software testing
2. Basics of agility and agile testing
3. Statistic software quality measures and black box test design techniques
4. White box test design techniques and code-driven metrics
5. Test automation I (general introduction and use in the classic process model)
6. Test automation II (use in the agile process model)
7. Test management, management-driven metrics and test planning and _estimates
8. Tool support and non-functional tests I (usability, security, operational tests)
9. Non-functional tests II (load and performance tests)
10. Final exercise (group work)

[*updated 24.02.2018*]

Teaching methods/Media:
Slides -

The slides can be used as a script and will be made available to students. In addition, selected articles on the topics of the lecture will be recommended.

[*updated 20.12.2017*]

Recommended or required reading:
Andreas Spillner,Tilo Linz:
Basiswissen Softwaretest: Aus- und Weiterbildung zum Certified Tester - Foundation Level nach ISTQB-Standard (ISQL-Reihe), dPunkt Verlag

[*updated 20.12.2017*]

Strategic Communication for Technology Selection Seminar

Module name (EN): Strategic Communication for Technology Selection Seminar

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-SKTA

Hours per semester week / Teaching method:
4S (4 hours per week)

ECTS credits:
6

Semester: according to optional course list

Mandatory course: no

Language of instruction:
German

Assessment:
Term paper with presentation

[*updated 23.11.2020*]

Applicability / Curricular relevance:

KIM-SKTA (P221-0160) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , optional course, telecommunications-specific
PIM-SKTA (P221-0160) Applied Informatics, Master, ASPO 01.10.2017 , optional course, informatics specific
PIM-SKTA (P221-0160) Applied Informatics, Master, SO 01.10.2026 , optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Steffen Knapp

Lecturer: Prof. Dr. Steffen Knapp

[*updated 27.08.2020*]

Learning outcomes:
After successfully completing this module, students will be able to independently access, process and reproduce the content of complex scientific topics, both orally and in writing. In addition, they will be able to actively participate and hold their own in scientific discussions.

[*updated 23.11.2020*]

Module content:
In many areas of professional life, one must make decisions regarding the technologies to be used for specific tasks.
Depending on the area of application and the respective objectives, different requirements will be placed on the technology to be used.
Often there is competition between potentially suitable technologies.

During this seminar, students will choose a technology by way of example.
In this context, we will take a closer look at different points of view.

[*updated 23.11.2020*]

Recommended or required reading:

[*still undocumented*]

Traffic Control and Traffic Management

Module name (EN): Traffic Control and Traffic Management

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-VSVM

Hours per semester week / Teaching method:
4V (4 hours per week)

ECTS credits:
6

Semester: 2

Mandatory course: no

Language of instruction:
German

Assessment:
Oral examination

[*updated 21.12.2023*]

Applicability / Curricular relevance:

E2936 (P222-0097) Electrical Engineering and Information Technology, Master, ASPO 01.04.2019 , semester 2, optional course, technical
FTM-KVUV (P222-0097) Automotive Engineering, Master, ASPO 01.04.2021 , semester 2, optional course
FTM-KVUV (P222-0097) Automotive Engineering, Master, ASPO 01.04.2023 , semester 2, optional course
KI833 Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 2, optional course, telecommunications-specific
KIM-VSVM (P222-0097) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 2, optional course, telecommunications-specific
MAM.2.1.4.10 (P222-0097) Engineering and Management, Master, ASPO 01.10.2013 , semester 2, optional course, technical
PIM-WI77 Applied Informatics, Master, ASPO 01.10.2011 , semester 2, optional course, informatics specific
PIM-VSVM (P222-0097) Applied Informatics, Master, ASPO 01.10.2017 , semester 2, optional course, informatics specific
PIM-VSVM (P222-0097) Applied Informatics, Master, SO 01.10.2026 , semester 2, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Horst Wieker

Lecturer: Prof. Dr. Horst Wieker

[*updated 10.11.2016*]

Learning outcomes:
After successfully completing this module, students will be able to correctly classify traffic control and traffic management methods and procedures.

They will be able to describe the requirements and challenges of traffic control from an operational point of view.

Students will be able to apply the traffic flow theory to traffic control procedures. In doing so, they will be able to evaluate urban traffic disturbances and highway traffic control correctly in order to be able to make recommendations for control procedures. Students will also be able to take the operational view of traffic into account.

In addition, students will be capable of applying methodological approaches and explaining the data standards used.

Students will be able to describe the technical requirements of cooperative systems (Car2X) on the infrastructure and be able to assign them to vehicle-related applications.

The goal of this module is to enable students to analyze future development trends in traffic management and assess their effects.

[*updated 26.02.2018*]

Module content:
1. Definition of traffic management and traffic control and the differentiation between urban and suburban areas
2. Extra-urban traffic control systems
3. Urban traffic control systems
4. Traffic management
5. Extra-urban data standards
6. Urban data standards
7. Planning process and planning tools
8. Integrated traffic management, strategy management
9. Telematics, vehicle-related applications
10. Infrastructure quality in Germany
11. Infrastructure quality ROW and in particular, USA
12. Car2X and Car2Car, application overview
13. Car2X demands on traffic infrastructure
14. Intermodal traffic management
15. Outlook/Development trends in traffic management and control

[*updated 26.02.2018*]

Recommended or required reading:

[*updated 21.12.2023*]

Virtual Machines and Program Analysis

Module name (EN): Virtual Machines and Program Analysis

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-VMPA

Hours per semester week / Teaching method:
2V+4P (6 hours per week)

ECTS credits:
8

Semester: 1

Mandatory course: no

Language of instruction:
German

Assessment:
Written exam, project

[*updated 26.02.2018*]

Applicability / Curricular relevance:

KI744 Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 1, optional course, informatics specific
KIM-VMPA (P221-0148) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 1, optional course, informatics specific
PIM-WI55 (P221-0147) Applied Informatics, Master, ASPO 01.10.2011 , semester 1, optional course, informatics specific
PIM-VMPA (P221-0148) Applied Informatics, Master, ASPO 01.10.2017 , semester 1, optional course, informatics specific
PIM-VMPA (P221-0148) Applied Informatics, Master, SO 01.10.2026 , semester 1, optional course, informatics specific

Workload:
90 class hours (= 67.5 clock hours) over a 15-week period.
The total student study time is 240 hours (equivalent to 8 ECTS credits).
There are therefore 172.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Dr.-Ing. Jörg Herter

Lecturer: Dr.-Ing. Jörg Herter

[*updated 10.11.2016*]

Learning outcomes:
Students will become acquainted with the concept of and motivation behind virtual machines using the CMa as an example.
Students will be able to translate C code to CMa code.

Students will be familiar with the most important program analyses (available expressions, interval analysis, constant propagation, dead variables, etc.).
Students will be able to work out the (fixed-point) algorithms used in program analysis: naive fixed-point iteration, round robin, worklist, recursive iteration.
Students will understand the mathematics behind the methods of analysis, in particular the concept of complete lattices.

State-of-the-art analyzers will be used in the project "Statische Analyse von sicherheitskritischem C-Code" to analyze code used in industry. Students will gain insights into which analyses are technically possible and how the development/programming style of safety-critical software (e. g. from the aerospace or automotive industry) differs from the development of "normal software".

[*updated 26.02.2018*]

Module content:
1. Introduction (high-level programming languages, implementation of programming languages)
2. The architecture of CMa
3. Translating simple C language elements
4. Translating structs
5. Translating functions
6. Introduction (program analysis and transformations)
7. Operational semantics/CFGs
8. Not available and available expressions
9. Fixed point iteration: naive, round-robin, worklist and recursive iteration
10. Mathematical background (How can we prove that our analysis provides the best results resp. even terminates?)
11. Live, dead and strongly live variables
12. Equality of variables
13. Constant propagation and interval analysis

[*updated 06.09.2018*]

Recommended or required reading:
R. WILHELM, H. SEIDL: Übersetzerbau. Virtuelle Maschinen
H. SEIDL, R. WILHELM, S. HACK: Übersetzerbau. Analyse und Transformation
F. NIELSON, H. NIELSON, C. HANKIN: Principles of Program Analysis
P. COUSOT, R. COUSOT: Abstract interpretation: a unified lattice model for static analysis of programs by construction or approximation of fixpoints

[*updated 26.02.2018*]

Web Applications

Module name (EN): Web Applications

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-WEBA

Hours per semester week / Teaching method:
2V+2U (4 hours per week)

ECTS credits:
6

Semester: 2

Mandatory course: no

Language of instruction:
German

Assessment:
Lecture, tests, exercises

[*updated 05.06.2025*]

Applicability / Curricular relevance:

KI834 Computer Science and Communication Systems, Master, ASPO 01.04.2016 , semester 2, optional course, informatics specific
KIM-WEBA (P221-0150, P222-0131) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 2, optional course, informatics specific
PIM-WI49 (P221-0149) Applied Informatics, Master, ASPO 01.10.2011 , semester 2, optional course, informatics specific
PIM-WEBA (P221-0150, P610-0523) Applied Informatics, Master, ASPO 01.10.2017 , semester 2, optional course, informatics specific
PIM-WEBA (P221-0150, P610-0523) Applied Informatics, Master, SO 01.10.2026 , semester 2, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Thomas Kretschmer

Lecturer: Prof. Dr. Thomas Kretschmer

[*updated 21.01.2018*]

Learning outcomes:
Students will be given an overview of the current status of the most important tools and technologies for developing web applications. They will be able to analyze a given task and decide which technologies are most suitable for solving it. In addition, they will be able to create the respective web application together with their team.

[*updated 24.02.2018*]

Module content:
Use of Node.js
Frontend frameworks (mainly using Vue.js)
Backend frameworks (for example, Express)
Various areas of specialization, e.g., front-end testing, internationalization, state management, functional programming with JavaScript

[*updated 05.06.2025*]

Teaching methods/Media:
Presentations by students with examples
Exercises
Inverted classroom

[*updated 05.06.2025*]

Recommended or required reading:
Rauschmayer, Axel: Deep JavaScript, https://exploringjs.com/deep-js/index.html
Springer, Sebastian: Node.js: Das umfassende Handbuch. Serverseitige Webapplikationen mit JavaScript entwickeln, Rheinwerk Computing; Auflage: 2 (30. Mai 2016)
Vue.js: https://vuejs.org/
Node.js: https://nodejs.org/dist/latest/docs/api/

[*updated 05.06.2025*]

Web Development

Module name (EN): Web Development

Degree programme: Applied Informatics, Master, SO 01.10.2026

Module code: PIM-WEB

Hours per semester week / Teaching method:
2V+2U (4 hours per week)

ECTS credits:
6

Semester: 3

Mandatory course: no

Language of instruction:
German

Assessment:

[*still undocumented*]

Applicability / Curricular relevance:

KIM-WEB (P221-0209) Computer Science and Communication Systems, Master, ASPO 01.10.2017 , semester 3, optional course
PIM-WEB (P221-0209) Applied Informatics, Master, ASPO 01.10.2017 , semester 3, optional course
PIM-WEB (P221-0209) Applied Informatics, Master, SO 01.10.2026 , semester 3, optional course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.

The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 135 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Maximilian Altmeyer

Lecturer: Prof. Dr. Maximilian Altmeyer

[*updated 31.07.2017*]

Learning outcomes:
Students will be given an overview of the current status of the most important tools and technologies for developing web applications. They will be able to analyze a given task and decide which technologies are most suitable for solving it. In addition, they will be able to create the respective web application together with their team.

[*updated 20.12.2017*]

Module content:
Basics (HTML5, CSS3, JavaScript)
EcmaScript6
Functional programming with JavaScript
Use of Node.js
GUI frameworks (e.g. Angular, Polymer, React)
Full stack frameworks (e.g. Meteor)

[*updated 20.12.2017*]

Teaching methods/Media:
Presentation with examples
Exercises
Project

[*updated 24.02.2018*]

Recommended or required reading:
Rauschmayer, Axel: Speaking JavaScript, http://speakingjs.com/es5/
Rauschmayer, Axel: Exploring ES6, http://exploringjs.com/
Springer, Sebastian: Node.js: Das umfassende Handbuch. Serverseitige Webapplikationen mit JavaScript entwickeln,Rheinwerk Computing; Auflage: 2 (30. Mai 2016)
W3C: HTML5, http://www.w3.org/TR/html5/

[*updated 24.02.2018*]