TECHNISCHE HOCHSCHULE
OSTWESTFALEN-LIPPE
UNIVERSITY OF
APPLIED SCIENCES
AND ARTS

Faculty of
Computer Science and Automation

Module Manual for the Degree Program Information Technology, M.Sc.

(PO-Version 2025)

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Advanced Topics in Algorithms (ATA / 11952)

Module name	Advanced Topics in Algorithms
Module number	11952
Module responsible	Prof. Dr. Markus Lange-Hegermann
Teacher	Dr. Niels Grüttemeier
Frequency of offers	winter semester only
Duration in semesters	1
Teaching language	English
Use of the module in degree programs / semesters	Information Technology (Master) PO 2019: 1. Semester, Pflicht Information Technology (Master) PO 2025: 1. Semester, Pflicht
Form(s) of teaching / Hours per week	Lecture / 2 hours per week Exercises / 2 hours per week
Workload (contact hours / self-study)	150 h = 60 hours confrontation time (lectures, exercises, and labs) plus 90 hours additional student individual work / homework time
ECTS	5
Recommended prerequisites	Software development skills using object- oriented programming languages
Target competencies	Competence to describe, analyze and benchmark algorithms. Students of Information Technology have the skills to identify task-specific requirements and are capable of selecting suitable algo- rithms. They are able to implement algorithms in an object-oriented programming language.
Contents	Complexity and benchmarking of algorithms, optimization of algo- rithms, knowledge engineering and machine learning algorithms, e.g. propositional and first order logic, probabilistic state machines and hidden Markov models, rule-based systems, adaptive resonance the- ory algorithms; implementation of algorithms
Examination performance(s) including duration / scope	Written examination, oral examination, written report. The grade equals the grade for the module.
Literature	Sedgewick, R.: Algorithms. Pearson, 2011. Cormen, T. H./Leiserson, C.E/Rivest, R.L./Stein, C: Introduction to Al- gorithms. MIT Press, 2nd edition, 2001. Dasgupta, S./Papadimitriou, C., Vazirani, U.: Algorithms. Higher Edu- cation. McGrawHill, 1st edition, 2008. Jones, M.T: AI Application Programming. Charles River Media, 2003. Russel, S. / Norvig, P.: Artificial Intelligence - A Modern Approach. Pearson Education / Prentice Hall, 2nd edition, 2003.

Advanced Topics in Machine Learning (AML / 11663)

Module name	Advanced Topics in Machine Learning
Module number	11663
Module responsible	Prof. Dr. Markus Lange-Hegermann
Teacher	Prof. Dr. Markus Lange-Hegermann
Frequency of offers	summer semester only
Duration in semesters	1
Teaching language	English
Use of the module in degree programs / semesters	Elektrotechnik (Master) PO 2019: 2. Semester, Wahlpflicht Elektrotechnik (Master) PO 2025: 2. Semester, Wahlpflicht Information Technology (Master) PO 2019: 2. Semester, Wahlpflicht Information Technology (Master) PO 2025: 2. Semester, Wahlpflicht
Form(s) of teaching / Hours per week	Seminar / 4 hours per week
Workload (contact hours / self-study)	150 h = 60 hours confrontation time (lectures and exercises) plus 90 hours additional student individual work / homework time
ECTS	5
Recommended prerequisites	Undergraduate mathematics; knowledge of probability and statistics, knowledge of programming and data structures
Target competencies	The students know and understand basic concepts of machine learning and are able to apply them to given problems. Students are able to look for and understand additional algorithms by studying the relevant literature in Machine Learning.
Contents	Foundations of machine learning: (un)supervised learning, overfitting, double descent, Ockham's razor, and models. Loss functions and models in logistic and linear regression. Deep neural networks, recurrency, convolution, transformers, backpropagation, batchnorm, layernorm, groupnorm, including applications in time series, and images. Large language models and prompting. Gaussian processes, kernel methods and kernel algebra, covariance structures, sampling, and variance estimations. Generative methods like PCA, autoencoders and VAEs. The knowledge about these algorithms is in part acquired by the students themselves from both textbooks and current papers. Practical sessions are being held to implement such machine learning algorithms. The course ends with presentations by students on current papers in ML.
Examination performance(s) including duration / scope	Oral examination, duration 30 minutes. The grade equals the grade for the module.
Literature	Bishop, Pattern Recognition and Machine Learning, Springer, 2007. Courville, Goodfellow, Bengio, Deep Learning. MIT Press, 2016. Rasmussen, Williams, Gaussian Processes for Machine Learning. MIT Press, 2005. Jaynes, Probability Theory: The Logic of Science. Cambridge University Press /(CUP), 2003. Murphy, Probabilistic Machine Learning: An Introduction. CUP, 2022.

	Murphy, Probabilistic Machine Learning: Advanced Topics. CUP, 2023. Current papers: arXiv, JMLR, NeurIPS, ICML.

Authentication (AUT / 11814)

Module name	Authentication
Module number	11814
Module responsible	Prof. Dr. Helene Dörksen
Teacher	Prof. Dr. Helene Dörksen
Frequency of offers	summer semester only
Duration in semesters	1
Teaching language	English
Use of the module in degree programs / semesters	Information Technology (Master) PO 2019: 2. Semester, Wahlpflicht Information Technology (Master) PO 2025: 2. Semester, Wahlpflicht Smart Health Sciences (Master) PO 2020: 2. Semester, Pflicht
Form(s) of teaching / Hours per week	Lecture / 2 hours per week Exercise / 1 hour per week Lab / 1 hour per week
Workload (contact hours / self-study)	150 h = 60 hours confrontation time (lectures and exercises) plus 90 hours additional student individual work / homework time
ECTS	5
Recommended prerequisites	Mathematics 1-4, Machine Learning, Statistics, Applied and Discrete Mathematics
Target competencies	The students are able to familiarize themselves with the theoretical foundations of questions relevant to authentication. They are capable of developing suitable solution concepts for specific problems.
Contents	**Lecture:** The lecture introduces theoretical topics with relevance to authentication; i.e.: - methods of non-linear signal and image processing, - multivariate data analysis, - feature engineering, - classification optimization and - automation methods for authentication systems. The lecture also tackles many application scenarios of authentication methods within health and life sciences. In addition, a look is taken at the following fields of application: - banknote authentication, - error identification in the monitoring of textile manufacturing processes, - authentication of geometric structures in digital spaces. **Exercise / Lab:** The lecture contents are deepened on the basis of appropriate tasks. For particular tasks, Matlab is used.
Examination performance(s) including duration / scope	Preparation of Term Paper (length: 20 pages, preparation time period: 8 weeks). The grade equals the grade for the module.
Literature	Guyon, I.M., Gunn, S.R., Nikravesh, M. and Zadeh, L. (eds.) (2006): Fea- ture Extraction, Foundations and Applications, Springer Ethem Alpaydin (2014): Introduction to Machine Learning (3nd ed.). The MIT Press.

	Alice Zheng, Amanda Casari (2018): Feature Engineering for Machine Learning: Principles and Techniques for Data Scientists, O'Reilly Media Maimon, Oded, Rokach, Lior. (2010). Data Mining and Knowledge Dis- covery Handbook, 2nd ed., Springer Esther M. Arkin, L. Paul Chew, Daniel P. Hüttenlocher, Klara Kedem, Joseph S. B. Mitchell (1991): An Efficiently Computable Metric for Comparing Polygonal Shapes. IEEE Trans. Pattern Anal. Mach. Intell. 13(3): 209-216 Isabelle Debled-Rennesson, Jean-Luc Rémy, Jocelyne Rouyer-Degli (2000): Detection of the Discrete Convexity of Polyominoes. DGCI, 491-504 L. J. Latecki and R. Lakämper (2000): Shape Similarity Measure Based on Correspondence of Visual Parts. IEEE Trans. Pattern Analysis and Machine Intelligence (PAMI) 22 (10)

Autonomous Vehicles (AUV / 15152)

Module name	Autonomous Vehicles
Module number	15152
Module responsible	Prof. Dr.-Ing. habil. Ulrich Büker
Teacher	Prof. Dr.-Ing. habil. Ulrich Büker
Frequency of offers	summer semester only
Teaching language	English
Use of the module in degree programs / semesters	Elektrotechnik (Master) PO 2019: 2. Semester, Wahlpflicht Elektrotechnik (Master) PO 2025: 2. Semester, Wahlpflicht Information Technology (Master) PO 2019: 2. Semester, Wahlpflicht Information Technology (Master) PO 2025: 2. Semester, Wahlpflicht Mechatronische Systeme (Master) PO 2019: 2. Semester, Wahlpflicht
Form(s) of teaching / Hours per week	Lecture/Seminar : 2 hours per week Lab : 2 hours per week
Workload (contact hours / self-study)	60 hours confrontation time (lectures and exercises) plus 90 hours additional student individual work / homework time
ECTS	5
Mandatory prerequisites	/
Recommended prerequisites	/
Target competencies	The students know and understand the important areas of assisted driving and autonomous vehicles, including system design, the common sensor technologies, main functionalities. They are able to apply them and to implement algorithms for autonomous driving. The students are also able to independently develop a topic and to present it in front of a group.
Contents	In this course, we will discuss: • Sensor technologies used for assisted and autonomous vehicles e.g. ultrasonic, camera, lidar, radar • Feature functions like intelligent cruise control, automatic emergency break, lane keeping, assisted and autonomous parking • Systems engineering for AVs • Functional safety of autonomous vehicles • Test and validation of AVs • Legal and ethical aspects of autonomous driving
Examination performance(s) including duration / scope	Presentation with a length of 30 minutes and a processing time of 6 weeks. The grade equals the grade for the module.
Literature	Hermann Winner, et al (Edts.): Handbook of Driver Assistance Systems, Springer, 2016 Markus Maurer, et al (Edts.): Autonomous Driving: Technical, Legal and Social Aspects,

	Springer, 2016 Daniel Watzenig, Martin Horn (Edts.): Automated Driving Safer and More Efficient Future Driving, Springer, 2017 Yan Li, Hualiang Shi: Advanced Driver Assistance Systems and Autonomous Vehicles, From Fundamentals to Applications, Springer, 2022 Further literature will be announced during the course

Communication for Distributed Systems (CDS / 11951)

Module name	Communication for Distributed Systems
Module number	11951
Module responsible	Prof. Dr. Jürgen Jasperneite
Teacher	Prof. Dr. Jürgen Jasperneite Dipl.-Ing. Arne Neumann
Frequency of offers	summer semester only
Duration in semesters	1
Teaching language	English
Use of the module in degree programs / semesters	Elektrotechnik (Master) PO 2019: 2. Semester, Wahlpflicht Elektrotechnik (Master) PO 2025: 2. Semester, Wahlpflicht Information Technology (Master) PO 2019: 2. Semester, Wahlpflicht Information Technology (Master) PO 2025: 2. Semester, Wahlpflicht
Form(s) of teaching / Hours per week	Lecture / 2 hours per week Lab / 2 hours per week
Workload (contact hours / self-study)	150 h = 60 hours confrontation time (lectures and exercises) plus 90 hours additional student individual work / homework time
ECTS	5
Target competencies	**Knowledge:** The students are able to give an overview of protocol engineering for distributed real-time systems. This includes the presented formal description techniques, discrete event simulation and the perfor- mance evaluation of computer networks. **Comprehension:** The students are able to explain in detail the needed steps for a cred- ible performance evaluation of communication systems. They are able to describe the approach of discrete event simulation for per- formance evaluation. **Application:** The students are able to apply their knowledge to a practical case study using the DES tool omnet++.
Contents	Lecture: 1) System theory and technologies: Basic communication concepts and patterns, services and protocols, layered communication system. 2) Performance evaluation of computer networks using discrete event simulation. Lab: 1) Exercises related to lectures 2) Performance evaluation study of a communication protocol with omnetpp; output analysis and representation with Matlab or R.
Examination performance(s) including duration / scope	Written examination, duration 90 minutes. The grade equals the grade for the module.
Literature	Coulouris, G., Dollimore, J., Kindberg, T.: Distributed Systems, Concepts and Design. 4th rev. ed. Addison Wesley, 2005. Jain, R.: The Art of Computer Systems Performance Analysis. Techniques for Experimental Design, Measurement, Simulation and Modeling. Wiley, 1991. Popovic, M.: Communication Protocol

	Engineering. CRC, 2006. Tanenbaum, A. S., van Steen, M.: Distributed Systems. Principles and Paradigms. 2nd rev. ed. Prentice Hall, 2006.

Embedded Systems Design (ESD / 11658)

Module name	Embedded Systems Design
Module number	11658
Module responsible	Prof. Dr. Jürgen Jasperneite
Teacher	not specified
Frequency of offers	summer semester only
Duration in semesters	1
Teaching language	English
Use of the module in degree programs / semesters	Elektrotechnik (Master) PO 2019: 2. Semester, Wahlpflicht Elektrotechnik (Master) PO 2025: 2. Semester, Wahlpflicht Information Technology (Master) PO 2019: 2. Semester, Wahlpflicht Information Technology (Master) PO 2025: 2. Semester, Wahlpflicht
Form(s) of teaching / Hours per week	Lecture/2hours perweek Exercise/2hoursperweek
Workload (contact hours / self-study)	150 h = 60 h confrontation time, 90 h homework time
ECTS	5

Target competencies	**Knowledge:** Studentsgainknowledgeinthefieldofembeddedsystems.Thisincludes generic system design aspects, sensors and actuators, microprocessor basics, HDL design, components of embedded systems, testing of embedded systems, FPGA basics, embedded software integration, and hardware-based acceleration approaches. **Comprehension:** Students gain competencies in the design of embedded systems with focus on real-time issues. They are able to specify embedded systems andexplorethedesignspaceaccordingtoapplicationalre-quirementsas well as to implement and test embedded systems. Accordingto the wide range of the covered topics,the studentsare able to understand the correlation between the different aspects of embedded system design. **Application:** Thestudentsareabletoapplytheirknowledgeinordertodesign practical embedded systems based on FPGA technologies.
Contents	**Lecture:** 1.Introduction to embedded systems: What are embedded systems, requirementsforembeddedsystems,andcommunicationap-proaches? 2.System theoryandtechnologies:Signalprocessing chain,embed-dedprocessorbasics,bussystems,memoryconcepts,externalinterfaces, multi- and coprocessor concepts 3.Softwareconcepts:codedevelopment,tool-chains,operatingsys- tems for embedded systems 4.Applicationexamplesfromthedomainofindustrialautomation **Lab:** 1.Exercisesrelatedtolectures 2.Fundamentals ofFPGAdesign 3.EmbeddedFPGA-basedsystemdesignincludingembeddedCPUs Exemplaryimplementationofembeddedsoftwareforindustrial usage
Examination perfor-mance(s) including dura-tion / scope	Writtenexamination,duration90minutes. Thegradeequalsthegradefor the module.
Literature	P.Marwedel:EmbeddedSystemDesign.Springer,2018.Hennessy,J. L.: Computer Architecture. A Quantitative Approach. Morgan Kaufmann,

	2017. Thomas,D.,Moorby,Philip:TheVerilog®HardwareDescription Language. Springer, 2008.

Gamification Innovation Lab (GIL / 16088)

Module name	Gamification Innovation Lab
Module number	16088
Module responsible	Prof. Dr.-Ing. Rainer Rasche
Teacher	Prof. Dr.-Ing. Rainer Rasche
Teaching language	English
Use of the module in degree programs / semesters	Elektrotechnik (Master) PO 2019: 1. Semester, Wahlpflicht Elektrotechnik (Master) PO 2025: 1. Semester, Wahlpflicht Information Technology (Master) PO 2019: 1. Semester, Wahlpflicht Information Technology (Master) PO 2025: 1. Semester, Wahlpflicht Mechatronische Systeme (Master) PO 2019: 1. Semester, Wahlpflicht
Form(s) of teaching / Hours per week	Lab / 4 hours per week
Workload (contact hours / self-study)	60 hours confrontation time plus 90 hours additional student individual work/homework time
ECTS	5
Mandatory prerequisites	/
Recommended prerequisites	/
Target competencies	**Collaborate effectively** in international, multilingual, and cross-institutional teams (bridging high school and university). **Apply AI-based and digital tools** creatively to develop prototypes, simulations, or serious games with practical relevance. **Design and implement** interdisciplinary projects at the intersection of education, technology, and gaming. **Communicate and present** complex ideas in English and German within academic, professional, and intercultural contexts. **Reflect critically** on the societal, ethical, and educational implications of gaming technologies and digital learning environments. **Transfer academic knowledge** into real-world applications through partnerships with cultural, industrial, and educational institutions.
Contents	The module focuses on the design and implementation of interdisciplinary projects that combine education, gaming, artificial intelligence (AI), and digital media. Students explore methods of game-based learning, serious games, and VR/AR applications as tools for education, communication, and professional training. Through project-based work, they apply AI-driven tools for creative development and evaluate the social, ethical, and educational dimensions of gaming technologies. Collaborations with partners such as schools, cultural institutions (e.g., HiScore Gaming Museum Hannover), and regional networks (e.g., Lippe Bildung eG, IWD Lemgo) enable practical transfer and reflection. The course integrates virtual learning formats (e.g., hybrid and online collaboration) and emphasizes teamwork, prototyping, and presentation of results to both academic and public audiences.

Examination performance(s) including duration / scope	Presentation (duration 20 min.) and composition (comprising 15 - 20 pages with a processing time of 18 weeks)
Literature	Yannakakis, G. N., & Togelius, J. (2018). Artificial Intelligence and Games. Springer. # Technical and algorithmic approaches (procedural generation, reinforcement learning, adaptive behavior). Rolland, C., & Wright, W. (2020). Serious Games for Engineering Education: Design and Implementation. IEEE Transactions on Education. # Case studies and architectures for simulation-based learning in engineering. Kapp, K. M. (2012). The Gamification of Learning and Instruction. Pfeiffer. # Still useful for understanding motivation, feedback, and user-engagement design. Craighead, J., & Murphy, R. R. (2017). Simulation and Training Systems for Robotics and Mechatronics. In Springer Handbook of Robotics. Springer. # Connects gamified simulation environments with real engineering applications. Azuma, R. T. (2017). A Survey of Augmented Reality. Presence: Teleoperators and Virtual Environments, 6(4). # Core background for anyone working with AR/VR in technical or educational systems.

Industrial Software Engineering (ISE / 11780)

Module name	Industrial Software Engineering
Module number	11780
Module responsible	Prof. Dr. Jessica Rubart
Teacher	Prof. Dr. Jessica Rubart
Frequency of offers	summer semester only
Duration in semesters	1
Teaching language	English
Use of the module in degree programs / semesters	Information Technology (Master) PO 2019: 1. Semester, Wahlpflicht Information Technology (Master) PO 2025: 1. Semester, Pflicht
Form(s) of teaching / Hours per week	Lecture / 2 hours per week Exercises / 2 hours per week
Workload (contact hours / self-study)	150 h = 60 hours confrontation time (lectures and exercises) plus 90 hours additional student individual work / homework time
ECTS	5
Target competencies	Students acquire the skills needed to manage software development projects. This includes the definition of an optimal software development method for a given project, identifying agile or disciplined practices suited for the project's specific needs. Students learn how to manage the resources needed to complete projects that meet business objectives. In addition, requirements engineering, risk management, knowledge management, and process improvement are important competence fields targeted by this course.
Contents	Industrial software development process frameworks, such as the Rational Unified Process and the agile change management approach Scrum Principles of Lean Software Development Process improvement with Six Sigma Designing software for and with reuse Software architecture
Examination performance(s) including duration / scope	Written examination. The grade equals the grade for the module.
Literature	Herzum, P., Sims, O.: Business Component Factory: A Comprehensive Overview of Component-Based Development for the Enterprise. OMG / John Wiley, 2000. Poppendieck, M. and T.: Implementing Lean Software Development, Addision-Wesley, 2007. Pyzdek, T., Keller, P. A.: The Six Sigma Handbook. 3rd ed. New York: McGraw-Hill, 2009. Sommerville, I.: Software Engineering. Ninth edition. Pearson, 2010. Schwaber, K.: Agile Project Management with Scrum. Microsoft Press, 2004. Yacoub, S. M., Ammar, H. H.: Pattern-Oriented Analysis and Design: Composing Patterns to Design Software Systems. Addision-Wesley, 2003

Information Fusion (IFU / 11828)

Module name	Information Fusion
Module number	11828
Module responsible	not specified
Teacher	not specified
Frequency of offers	summer semester only
Duration in semesters	1
Teaching language	English
Use of the module in degree programs / semesters	Elektrotechnik (Master) PO 2019: 2. Semester, Wahlpflicht Elektrotechnik (Master) PO 2025: 2. Semester, Wahlpflicht Information Technology (Master) PO 2019: 2. Semester, Wahlpflicht Information Technology (Master) PO 2025: 2. Semester, Wahlpflicht
Form(s) of teaching / Hours per week	Lecture / 3 hours per week Lab / 1 hour
Workload (contact hours / self-study)	150 h = 60 hours confrontation time (lectures and exercises) plus 90 hours additional student individual work / homework time
ECTS	5
Recommended prerequisites	Mathematics for undergraduates, Statistics, Signals and Systems or System Modeling and Analysis, Image Analysis or Digital Image Processing
Target competencies	**Analyse:** The students are able to discuss sensor and information fusion concepts as well as methodologies. **Evaluate:** Furthermore, they are able to operationalize mathematical models in information fusion. **Create:** Students are also able to apply these concepts to real life scenarios, like machine conditioning.
Contents	Information Fusion identifies the concept of combining data from different information sources, such as sensors or human experts. The conceptual strategy is based on obtaining new or more certain information by data combination. In numerous applications it is not possible to capture all necessary information or features by a single sensor source. In such cases more sensors and additive experts' know-how can generate more precise data regarding different real world systems, e.g. robots, machines and equipment, data experts systems, cognitive systems and so on. The following topics are highlighted: - sensory signal representation fusion Methods - fusion models / multi-sensor fusion human-centric models - probability theory incl. Bayes decision trees Dempster-Shafer Theory - Fuzzy set Theory - possibility theory, real world examples
Examination performance(s) including duration / scope	Written exam, duration 120 minutes or Programming project with presentation, duration 30 minutes The grade equals the grade for the module.
Literature	Solaiman, B; Bossé, É: Possibility Theory for the Design of Information Fusion Systems, Springer 2019.

	Bossé, É; Rogova, G. L.: Information Quality in Information Fusion and Decision Making (Information Fusion and Data Science), April 2019, Springer. Bosse, É.: Concepts, Models, and Tools for Information Fusion. Artech, 2007. Campos, F.: Decision Making in Uncertain Situations. An Extension to the Mathematical Theory of Evidence. Diss. Boca Raton, 2006. Shafer, G.: A Mathematical Theory of Evidence. Princeton University Press, 1976. Thomas, C. (Ed.): Sensor Fusion. Foundation and Applications. InTech, 2011. Thomas, C. (Ed.): Sensor Fusion and Its Applications. Sciyo, 2010. Additional literature sources with current references (books, papers and online sources) will be announced in the respective lecture or exercise unit Additional literature sources with current references (books, papers and online sources) will be announced in the respective lecture or exercise unit.

Innovation and Development Strategies (IDS / 11763)

Module name	Innovation and Development Strategies
Module number	11763
Module responsible	not specified
Teacher	M.Sc., M.Tech. Saurav Borborah Prof. Dr. Reinhard Doleschal Prof. Dr. Volker Lohweg Prof. Dr. Andreas Welling
Frequency of offers	summer semester only
Duration in semesters	1
Teaching language	English
Use of the module in degree programs / semesters	Elektrotechnik (Master) PO 2019: 2. Semester, Pflicht Elektrotechnik (Master) PO 2025: 2. Semester, Pflicht Information Technology (Master) PO 2019: 2. Semester, Pflicht Information Technology (Master) PO 2025: 2. Semester, Pflicht Mechatronische Systeme (Master) PO 2019: 2. Semester, Pflicht
Form(s) of teaching / Hours per week	Lecture / 2 hours per week Seminar / 2 hours per week
Workload (contact hours / self-study)	150 h = 60 hours confrontation time (lectures and exercises) plus 90 hours additional student individual work / homework time
ECTS	5
Recommended prerequisites	Elementary management skills
Target competencies	**Analyse:** The students are able to understand and discuss about fundamental principles and methods for innovation and development processes based on intercultural R&D strategies, knowledge management, portfolio analysis, risk management, and patent strategies for international companies. **Evaluate:** Students are able to evaluate e.g. patent applications and patents. **Create:** Furthermore, they are able to operationalize concepts e.g. on building international teams.
Contents	Intercultural management: - What is culture? Cultural behavior, International R&D teams Knowledge management: - What is company knowledge? How to handle knowledge? Knowledge distribution strategies Development processes: - Portfolio analysis, risk analysis, FMEA, processes for mass products, processes for single products Patent management: - What are patents, patents applications, trademarks? How to read patents? Patent processing
Examination performance(s) including duration / scope	Engineering Project (homework) with presentation, duration approx.15 minutes and written exam, duration 60 minutes. The grade consists equally of both parts. Or written exam 120 minutes (special case).

Literature	Basis: Davenport, T. H., Prusak, L: Working Knowledge. How Organizations Manage What They Know. Harvard, 1997. Eversheim, W. (Ed.): Innovation Management for Technical Products. RWTH Edition. Springer, 2008. Jacob, N.: Intercultural Management. MBA Masterclass. Kogan Page, 2003. Nonaka, I., Takeuchi, H.: The Knowledge-Creating Company. How Japanese Companies Create the Dynamics of Innovation. Oxford University Press, 1995. Rapaille, C.: The Culture Code. Random House, 2006. Stim, R.: Patent, Copyright and Trademark. A Desk Reference to Intellectual Property Law. Nolo, 2009. Vose, D.: Risk Analysis. A Quantitative Guide. 3rd ed. Wiley, 2008. Additional literature sources with current references (books, papers and online sources) will be announced in the respective lecture or exercise unit.

Intelligent Technical Systems (ITS / 11563)

Module name	Intelligent Technical Systems
Module number	11563
Module responsible	not specified
Teacher	not specified
Frequency of offers	summer semester only
Duration in semesters	1
Teaching language	English
Use of the module in degree programs / semesters	Elektrotechnik (Master) PO 2019: 2. Semester, Wahlpflicht Elektrotechnik (Master) PO 2025: 2. Semester, Wahlpflicht Information Technology (Master) PO 2019: 2. Semester, Wahlpflicht Information Technology (Master) PO 2025: 2. Semester, Wahlpflicht
Form(s) of teaching / Hours per week	Lecture / 2 hours per week Exercises / 2 hours
Workload (contact hours / self-study)	150 h = 60 hours confrontation time (lectures and exercises) plus 90 hours additional student individual work / homework time
ECTS	5
Recommended prerequisites	Basic knowledge of algorithms and programming.
Target competencies	The students are able to understand and implement algorithms from the field of artificial intelligence. These algorithms are applied to the intelligent planning, configuration, diagnosis and optimization of technical systems. The main application area is industrial automation.
Contents	Block I: System Analysis: Models for diagnosis, finite state machine, discrete models, ODE-based models, physical, DAE-based and hybrid models (e.g. Modelica), simulation of these models Block II: System Diagnosis: Algorithms for anomaly detection and diagnosis Block III: System Configuration and Planning: Propositional logic, predicate logic, temporal logic, probabilistic logic, ontologies block, algorithms for configuration and planning
Examination performance(s) including duration / scope	Written examination. The grade equals the grade for the module.
Literature	Cellier, F; Kofman, E: Continuous System Simulation. Springer, 2010. Russel, S.; Norvig, P.: Artificial Intelligence. A Modern Approach. Prentice Hall, 2009. Tan, P. N.; Steinbach, M; Kumar, V.: Introduction to Data Mining. Pearson, 2013.

Colloquium Information Technology (KO / 11743)

Module name	Colloquium Information Technology
Module number	11743
Module responsible	not specified
Teacher	not specified
Teaching language	German
Use of the module in degree programs / semesters	Information Technology (Master) PO 2019: 4. Semester, Pflicht Information Technology (Master) PO 2025: 4. Semester, Pflicht
ECTS	5

Colloquium Information Technology (KO / 11886)

Module name	Colloquium Information Technology
Module number	11886
Module responsible	not specified
Teacher	not specified
Teaching language	German
Use of the module in degree programs / semesters	Information Technology (Master) PO 2019: 7. Semester, Pflicht Information Technology (Master) PO 2025: 7. Semester, Pflicht
ECTS	5

Management Skills and Business Administration (MBA / 11849)

Module name	Management Skills and Business Administration
Module number	11849
Module responsible	Prof. Dr.-Ing. habil. Ulrich Büker
Teacher	Dipl.-Wirt.-Ing. Nuri Gabriel
Frequency of offers	winter semester only
Duration in semesters	1
Teaching language	English
Use of the module in degree programs / semesters	Elektrotechnik (Master) PO 2019: 1. Semester, Pflicht Elektrotechnik (Master) PO 2025: 1. Semester, Pflicht Information Technology (Master) PO 2019: 1. Semester, Pflicht Information Technology (Master) PO 2025: 1. Semester, Pflicht Mechatronische Systeme (Master) PO 2019: 1. Semester, Pflicht
Form(s) of teaching / Hours per week	Seminar / 4 hours per week
Workload (contact hours / self-study)	150 h = 65 hours confrontation time (lectures and exercises) plus 85 hours additional student individual work / homework time
ECTS	5
Mandatory prerequisites	/
Target competencies	The students • are familiar with various company structures • understand team structures and how to manage and lead teams • understand strategies and models of internationalization and globalization • know the basics of project management and have already done projects themselves • are familiar with financing and accounting models of medium-sized enterprises and know the meaning of outside financing • know methods and instruments of business management, human resource management, marketing and KPI-based controlling • are familiar with means and methods of strategic business management • are able to handle modern media and have gained experience in presentations
Contents	Accounting, financing, balanced scorecard, marketing and research, strategic business management, leadership, internationalization, communication skills, presentation skills, rhetorical skills, intercultural studies, teamwork, creativity, how to deal with conflicts, how to lead a discussion, organization of projects, time management
Examination performance(s) including duration / scope	Presentation with a length of 30 minutes and a processing time of 6 weeks. The grade equals the grade for the module.
Literature	Robbins, S.R., Coulter, M.: Management. Pearson Education, 2021. Whittingtonb, R., Regner, P., Angwin, D. Johnson, G., Scholes, K.: Exploring Strategy, Pearson International, 2019. Lynch, R. L.: Strategic Management. Pearson, 2012. Kaplan, R. S., Norton,

	D. P.: The Balanced Scorecard. Harvard, 1996. Kotter, J. P.: Leading Change. Harvard, 1996 Further literature will be announced during the course.

Master's Thesis (MAA / 11759)

Module name	Master's Thesis
Module number	11759
Module responsible	not specified
Teacher	not specified
Frequency of offers	summer and winter
Duration in semesters	1
Teaching language	English
Use of the module in degree programs / semesters	Information Technology (Master) PO 2019: 4. Semester, Pflicht Information Technology (Master) PO 2025: 7. Semester, Pflicht
Form(s) of teaching / Hours per week	Independent processing of a practice-relevant task with a new scien- tific value
Workload (contact hours / self-study)	900 h
ECTS	25
Target competencies	The aim of the Master's Thesis is the interdisciplinary application of in- depth individual knowledge and skills using scientific methods. Thus, practical experience is gained and the methodical and profes- sional competence in the field of scientific application is extended, especially with regard to the defined tasks.
Contents	Depends on the respective engineering project
Examination performance(s) including duration / scope	Writtenreport,graded. The grade equals the grade for the module.
Prerequisite(s) for admission to examination(s)	All compulsory modules, Research Project
Literature	Depends on the subject of the Master's Thesis.

Master Thesis Information Technology (MAA / 11517)

Module name	Master Thesis Information Technology
Module number	11517
Module responsible	not specified
Teacher	not specified
Frequency of offers	summer and winter
Duration in semesters	1
Teaching language	English
Use of the module in degree programs / semesters	Information Technology (Master) PO 2019: 4. Semester, Pflicht Information Technology (Master) PO 2025: 4. Semester, Pflicht
Form(s) of teaching / Hours per week	Independent processing of a practice-relevant task with a new scien- tific value
Workload (contact hours / self-study)	900 h
ECTS	25
Target competencies	The aim of the Master's Thesis is the interdisciplinary application of in- depth individual knowledge and skills using scientific methods. Thus, practical experience is gained and the methodical and profes- sional competence in the field of scientific application is extended, especially with regard to the defined tasks.
Contents	Depends on the respective engineering project
Examination performance(s) including duration / scope	Writtenreport,graded. The grade equals the grade for the module.
Prerequisite(s) for admission to examination(s)	All compulsory modules, Research Project
Literature	Depends on the subject of the Master’s Thesis.

Network Security (NWS / 11678)

Module name	Network Security
Module number	11678
Module responsible	Prof. Dr.-Ing. Henning Trsek
Teacher	Prof. Dr.-Ing. Henning Trsek
Frequency of offers	summer semester only
Duration in semesters	1
Teaching language	English
Use of the module in degree programs / semesters	Elektrotechnik (Master) PO 2019: 2. Semester, Wahlpflicht Elektrotechnik (Master) PO 2025: 2. Semester, Wahlpflicht Information Technology (Master) PO 2019: 2. Semester, Wahlpflicht Information Technology (Master) PO 2025: 2. Semester, Wahlpflicht
Form(s) of teaching / Hours per week	Lecture / 2 hours per week Lab / 2 hour per week
Workload (contact hours / self-study)	150 h = 60 hours confrontation time (lectures and exercises) plus 90 hours additional student individual work / homework time
ECTS	5
Recommended prerequisites	Basic knowledge of networking and IP-related protocols
Target competencies	The students acquire solid knowledge about threats to security and privacy in networked and distributed systems. Different security mechanisms specified in current network protocols are known and can be rated with respect to their applicability. The students are familiar with the most important aspects of information security management and they are able to apply them to both, Information Technology (IT) and Operational Technology (OT) environments. The students carry out a detailed study of some selected security- related protocol or recently published attack (project work).
Contents	Networking applications and protocols and their vulnerabilities, IT security (aims, threats, secure programming), applied cryptography (basic mechanisms, selected algorithms and their applications), public key infrastructures (PKI), security and privacy in networked and distributed systems, transport layer security protocol (TLS), information security governance (according to ISO 27001), industrial security (IEC 62443).
Examination performance(s) including duration / scope	Written examination, duration 120 minutes. The grade equals the grade for the module.
Literature	Anderson, R.: Security Engineering. Wiley, 2008. Campbell, T.: Practical Information Security Management. Springer, 2016. Kaufman, C., Perlman, R. Speciner, M.: Network Security. Prentice Hall, 2002. Paar, C., Pelzl, J.: Understanding cryptography: A textbook for stu- dents and practitioners. Springer, 2010. Risitc, I.: Bulletproof SSL and TLS. Feisty Duck, 2014.

	Stallings, W.: Cryptography and Network Security. Principles and Practice. Pearson, 2016.

Probability and Statistics (PAS / 11866)

Module name	Probability and Statistics
Module number	11866
Module responsible	Prof. Dr. Stefan Heiss
Teacher	Prof. Dr. Stefan Heiss
Frequency of offers	winter semester only
Duration in semesters	1
Teaching language	English
Use of the module in degree programs / semesters	Elektrotechnik (Master) PO 2019: 1. Semester, Pflicht Elektrotechnik (Master) PO 2025: 1. Semester, Pflicht Information Technology (Master) PO 2019: 1. Semester, Pflicht Information Technology (Master) PO 2025: 1. Semester, Pflicht Smart Health Sciences (Master) PO 2020: 1. Semester, Pflicht
Form(s) of teaching / Hours per week	Lectures / 3 hours per week Exercises / 1 hour per week
Workload (contact hours / self-study)	150 h = 60 hours confrontation time (lectures and exercises) plus 90 hours additional student individual work / homework time
ECTS	5
Recommended prerequisites	Knowledge of mathematics from a Bachelor of Science program.
Target competencies	The students acquire solid knowledge about fundamental definitions and theorems from the fields of probability theory and statistics. Upon completion of the course, students shall be able to perform statistical parameter estimations and hypothesis testing of samples and to transfer these techniques e. g. to applications in the field of quality control.
Contents	- Basics of probability theory (sample space, event, probability, conditional probability, random variable, expectation, variance) - Special distributions, central limit theorem - Sampling, parameter estimation, hypothesis testing - Regression and analysis of variance - Goodness of fit and nonparametric testing - Quality control, product and system reliability
Examination performance(s) including duration / scope	Written examination (E-Exam), duration 120 minutes. The grade equals the grade for the module.
Literature	DeGroot, M. H.; Schervish, M. J.: Probability and Statistics. Pearson, 2010. Gubner, J. A.: Probability and Random Processes for Electrical and Computer Engineers. Cambridge University Press, 2006. Ross, S. M.: Introduction to Probability and Statistics for Engineers and Scientists. Academic Press, 2009.

Project Work (PRW / 15606)

Module name	Project Work
Module number	15606
Module responsible	Prof. Dr. mult. Carsten Röcker
Teacher	Prof. Dr. Jürgen Jasperneite Prof. Dr. Johannes Üpping
Duration in semesters	1
Teaching language	English
Use of the module in degree programs / semesters	Elektrotechnik (Master) PO 2019: 1. Semester, Wahlpflicht Elektrotechnik (Master) PO 2025: 1. Semester, Wahlpflicht Information Technology (Master) PO 2019: 1. Semester, Wahlpflicht Information Technology (Master) PO 2025: 1. Semester, Wahlpflicht Mechatronische Systeme (Master) PO 2019: 1. Semester, Wahlpflicht
Form(s) of teaching / Hours per week	Project: 4 hours per week
Workload (contact hours / self-study)	60 hours confrontation time plus 90 hours additional student individual work / homework time
ECTS	5
Mandatory prerequisites	/
Recommended prerequisites	/
Target competencies	Students broaden their learning experiences by applying, synthesizing and reflecting upon a specific project topic chosen by them. Designed as a team work for two or three students, individuals need to meet respective requirements and rules.
Contents	Possible topics are published at the beginning of the lecture period. The students need to organize their project work, check state-of-the-art solutions for the given problem, suggest a proposal, investigate the proposal and provide the results.
Examination performance(s) including duration / scope	Presentation (duration 20 min.) and composition (comprising 15 – 20 pages with a processing time of 18 weeks)
Literature	Depends on the topic

Research Project (RES / 11729)

Module name	Research Project
Module number	11729
Module responsible	not specified
Teacher	not specified
Duration in semesters	1
Teaching language	English
Use of the module in degree programs / semesters	Information Technology (Master) PO 2019: 3. Semester, Pflicht Information Technology (Master) PO 2019: 5. Semester, Pflicht Information Technology (Master) PO 2025: 3. Semester, Pflicht Information Technology (Master) PO 2025: 5. Semester, Pflicht
Form(s) of teaching / Hours per week	Independent processing of a research-oriented task
Workload (contact hours / self-study)	900 h
ECTS	30
Recommended prerequisites	Technical and methodical knowledge from the modules of the pre- ceding semesters of the Master's program
Target competencies	The students get acquainted with the procedural steps in the processing of research projects, from the preparation of the application to the final documentation. For this they are involved in the processing of subtasks of current research projects. The acquired com- petences prepare for the subsequent Master's Thesis.
Contents	The technical content depends on the specific research-oriented task. Variant 1: The students work on a subtask from a larger research project alone or in a team of two. Variant 2: The students work on several subtasks from different research projects alone or in a team of two.
Examination performance(s) including duration / scope	Composition with Colloquium, graded, The grade corresponds to the grade for the course.
Literature	Depends on the specific project

Scientific Methods and Writing (SMW / 11656)

Module name	Scientific Methods and Writing
Module number	11656
Module responsible	Prof. Dr. mult. Carsten Röcker
Teacher	M.Sc. Viktoria Mordaschew Prof. Dr. mult. Carsten Röcker
Frequency of offers	winter semester only
Duration in semesters	1
Teaching language	English
Use of the module in degree programs / semesters	Elektrotechnik (Master) PO 2019: 1. Semester, Pflicht Elektrotechnik (Master) PO 2025: 1. Semester, Pflicht Information Technology (Master) PO 2019: 1. Semester, Pflicht Information Technology (Master) PO 2025: 1. Semester, Pflicht Maschinenbau (Master) PO 2020: 1. Semester, Wahlpflicht Maschinenbau (Master) PO 2025: 1. Semester, Wahlpflicht Mechatronische Systeme (Master) PO 2019: 1. Semester, Pflicht Smart Health Sciences (Master) PO 2020: 1. Semester, Pflicht
Form(s) of teaching / Hours per week	Lecture / 2 hours per week Exercise / 2 hours per week
Workload (contact hours / self-study)	150 h = 60 hours confrontation time (lectures and exercises) plus 90 hours additional student individual work / homework time
ECTS	5
Target competencies	Students acquire basic knowledge about scientific writing and presenting. They understand typical structures of scientific papers and typical presentation styles. At the level of personality development, they gain problemsolving skills. In the practical part of the course, students gain hands-on experience in drafting, organizing and revising a scientific paper. The course is targeted at non-native English speakers with intermediate language abilities.
Contents	The course provides an introduction to and application of key principles of effective and efficient scientific writing. It provides key techniques, guidelines and suggestions to improve scientific writing skills. This includes a basic understanding of the writing strategy (research, planning, summarizing), the organization of the document (structure, argumentation) and the writing process (avoidance of plagiarism, proper referencing, proof-reading).
Examination performance(s) including duration / scope	Written examination, duration 90 minutes. The grade equals the grade for the module.
Literature	Turabian, K. L. (2013). A Manual for Writers of Research Papers, Theses, and Dissertations. The University of Chicago Press, Chicago, IL, USA. Sword, H. (2012). Stylish Academic Writing. Harvard University Press, Cambridge, MA, USA. Murray, R. (2005). Writing for Academic Journals. Open University Press, Maidenhead, Berkshire, UK. Strunk, W., White, E. B. (2000). The Elements of Style. Allyn & Bacon, Boston, MA, USA.

Special Topics in Information Technology (STI / 11684)

Module name	Special Topics in Information Technology
Module number	11684
Module responsible	not specified
Teacher	not specified
Frequency of offers	summer semester only
Duration in semesters	1
Teaching language	English
Use of the module in degree programs / semesters	Information Technology (Master) PO 2019: 2. Semester, Wahlpflicht Information Technology (Master) PO 2019: 4. Semester, Wahlpflicht Information Technology (Master) PO 2025: 2. Semester, Wahlpflicht
Form(s) of teaching / Hours per week	5 CR / 150 h
Workload (contact hours / self-study)	150 h = 60 hours confrontation time (lectures and exercises) plus 90 hours additional student individual work / homework time
ECTS	5
Target competencies	This compulsory optional module serves as a placeholder if a compulsory optional module with topics from the field of information technology can be offered. The module description is then specified.
Contents	Lecture: tbd. Exerciseg: tbd. Lab: tbd.
Examination performance(s) including duration / scope	Type of exam graded. The exam grade is the grade for the module.
Literature	tbd.

Usability Engineering (UEN / 11706)

Module name	Usability Engineering
Module number	11706
Module responsible	Prof. Dr. mult. Carsten Röcker
Teacher	M.Sc. Viktoria Mordaschew Prof. Dr. mult. Carsten Röcker
Frequency of offers	winter semester only
Duration in semesters	1
Teaching language	English
Use of the module in degree programs / semesters	Information Technology (Master) PO 2019: 1. Semester, Pflicht Information Technology (Master) PO 2025: 1. Semester, Pflicht
Form(s) of teaching / Hours per week	Lecture / 2 hours per week Exercises / 2 hours per week
Workload (contact hours / self-study)	150 h = 60 hours confrontation time (lectures and exercises) plus 90 hours additional student individual work / homework time
ECTS	5
Target competencies	Students gain theoretical and practical knowledge of the most important user-centered design techniques and their alignment in the development process. They are able to assess the individual strengths and weaknesses of different approaches for evaluating the usability of various types of information technologies. This includes the ability to plan and execute user studies for evaluating the usability of specific information technologies. In the practical part of the course, the students acquire experience in applying the various methods and techniques to a design task.
Contents	Today, the success of information technologies is largely influenced by its usability and user-friendly design has become an essential requirement for most systems. In this context, usability is defined as the extent to which a system can be used by a specific user to achieve a specific goal in a specific context with effectiveness, efficiency and satisfaction. In order to reach this goal, this course pro- vides basic principles of usability engineering methods for the design and evaluation of information technologies. This includes basic concepts of human-computer interaction, user interface design strategies, software development and evaluation methods as well as practical guidelines and standards.
Examination performance(s) including duration / scope	Written examination, duration 90 minutes. The grade equals the grade for the module.
Literature	Richter, M., Flückiger, M. (2014). User-Centred Engineering. Creating Products for Humans. Springer, Heidelberg. Bill Albert, Tom Tullis (2013). Measuring the User Experience: Collecting, Analyzing, and Presenting Usability Metrics. Morgan Kaufmann. Morgan Kaufmann, Burlington, MA, USA. Carol M. Barnum (2010). Usability Testing Essentials: Ready, Set...Test! Morgan Kaufmann, Burlington, MA, USA.

	Philip Kortum (2016). Usability Assessment: How to Measure the Usability of Products, Services, and Systems: User's Guides to Human Factors and Ergonomics Methods. Human Factors and Ergonomics Society. David C. C. Evans (2017). Bottlenecks: Aligning UX Design with User Psychology. Apress, New York, NY, USA.