ENGINEERING PF
SCHOOL OF ENGINEERING
Fakultät für Technik
Hochschule Pforzheim

HS PF

Syllabus

MWI10034 Networked Systems - Basics & Applications

Prof. Dr. Bernhard Kölmel

Winter Semester 2024/25

Level	Master	
Credits	3	
Student Contact Hours	2	
Workload	90 hours	
Prerequisites	none	
Time	s. LSF	
Room	s. LSF	
Start Date	s. LSF	
Lecturer(s)	**Name**	Prof. Dr. Bernhard Kölmel
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Summary

This course explores the fundamentals and applications of networked systems in the context of Industrial Engineering. Students will gain a comprehensive understanding of the interconnected world, Internet of Things (IoT), and their impact on future-oriented business models. The course covers various application areas, core competencies required in this field, and technology roadmaps for networked systems.

Outline of the Course

This comprehensive course is designed to provide students with a solid foundation in networked systems and their practical applications, with a particular focus on the Internet of Things (IoT). The course content covers both theoretical knowledge and hands-on experience, enabling participants to understand and leverage the potential of a fully connected world. Here's what students can expect from this course:

1. Fundamentals of Networked Systems
2. Internet of Things (IoT) Basics
3. IoT in Industrial and Business Contexts
4. Application Areas of Networked Systems
5. Future-Oriented Business Models
6. Core Competencies for Working with Networked Systems
7. Technology Roadmapping for Networked Systems

Throughout "Networked Systems - Basics & Applications," students will engage in a mix of theoretical lessons, practical exercises, group discussions, and project work. This approach will reinforce their learning and provide hands-on experience with networked systems and IoT technologies. By the end of the course, participants will have gained a comprehensive understanding of networked systems, developed practical skills in working with these technologies, and be equipped to drive innovation in their respective fields using the power of connectivity. The course aims to prepare students for the challenges and opportunities presented by an increasingly networked world, both in terms of technical understanding and strategic business application.

Course Intended Learning Outcomes and their Contribution to Program Intended Learning Outcomes / Program Goals

Program Intended Learning Outcomes		Course Intended Learning Outcomes
	After completion of the program the students will be able…	**After completion of the course the students will be able…**
1	**Responsible leadership in organizational contexts**	
2	**Creative problem solving skills in a complex business environment**	
2.1	…to recognize and define problems as well as assess their importance.	... to identify specific problems in connection with networked systems and their business models and to assess their impact on the company
2.2	…to analyse complex in-company and inter-company problems and challenges from different perspectives and/or within an international context.	... to analyze operational and inter-company challenges in the field of IoT from a technical and economic perspective. They learn how to assess problems in a national and international context and how different stakeholders are affected.
2.3	…to independently develop creative solutions to complex in-company and inter-company problems and challenges.	... to develop creative solutions through the use of methods and other creative problem-solving approaches.
2.4	…to clarify successfully complex problems and solutions to both experts and laymen.	... to communicate complex technical and economic concepts clearly and comprehensibly. They practise presentation techniques and the creation of comprehensible reports to present their solutions to both professionals and non-professionals.
3	**Research expertise and its practical application**	
3.1	…to demonstrate their knowledge of research methods relevant to engineering and management as well as their advantages and disadvantages.	... to demonstrate in-depth knowledge of relevant research methods in the field of IoT and business models, such as qualitative and quantitative analysis, case studies and experimental approaches.
3.2	…to successfully apply research methods relevant to engineering and management.	... to apply learned research methods in practical projects and case studies, e.g. by collecting and analyzing IoT data to develop and validate business models.
3.3	…to implement relevant research methods in such a way as to deliver reliable and innovative results.	... to use research methods effectively in projects and case studies in order to achieve reliable and innovative results. They develop hypotheses, conduct experiments and interpret the results in the context of IoT and business models.
4	**Interface competence in the technical-economic area**	
4.1	... to demonstrate sound knowledge in the technical and economic fields for the integrative solution of complex tasks.	... to demonstrate in-depth knowledge of both the technology of networked systems and the development and analysis of business models.
4.2	... apply the methods of project management and successfully organize, implement and manage projects.	... to demonstrate that they know project management methods and can implement them in practical projects. They can organize, plan and manage IoT projects including time and resource management, risk assessment and communication between technical and business stakeholders.
4.3	... to develop and evaluate alternative solutions, taking into account various specialist disciplines, and to implement them in integrative overall solutions.	... to combine technical and economic aspects in order to develop innovative and sustainable solutions. They can evaluate different approaches and implement them in integrative overall solutions that are both technically and economically optimized.

Teaching and Learning Approach

The teaching and learning approach is based on 3 didactical methods:

The theoretical key knowledge and the basic concepts are thought at the lecture. The students gain the methodology and the guidance to know and to implement the introduced concepts and tools. Questions and comments of the students are welcome during the lecture.
After the lecture the students should reflect and sum up the content of the lecture based on course materials provided.
The theoretical knowledge is enlarged and converted into a practical role by workshops and case studies. An active participation in class is an important part of the teaching and learning approach. The students can always communicate with the instructor and get support and advice by talking or mailing.

This course will also be enriched by guest speakers to maximize the outcome for the participating students: Industry experts and academics will be invited to share their experiences and insights throughout the course.

Literature and Course Materials

List of relevant textbooks, academic papers, and industry reports will be mentioned during the course, to be updated each semester.

Assessment

1. Mid-term exam (15%)

2. Applicaztion study analysis (15%)

3. Group project: Developing a future-oriented business model (50%)

4. Final presentation: Technology roadmap for a specific industry (20%)

Grading:
'Very good' (A grade) signifies that the performance is above and beyond expectations.
'Good' (B grade) means that the performance is good and above average.
'Satisfactory' (C grade) means that it is an average performance containing insufficiencies but principally appropriate to the expectations.
'Adequate' (D grade) describes a below-average performance with obvious deficiencies.
'Inadequate' (E grade) is an unacceptable performance that is not sufficient to any expectations.

Schedule

Date	Theme
Week 1-2	**Introduction to the Fully Networked World** - Historical context of networking - Current state of global connectivity - Challenges and opportunities in a networked world - Case studies of highly networked industries
Week 3-4	**Internet of Things (IoT)** - Fundamentals of IoT - IoT architecture and protocols - Sensors, actuators, and smart devices - Data collection, processing, and analysis in IoT - Security and privacy concerns in IoT
Week 5-6	**Future-Oriented Business Models in a Networked World** - Digital transformation of traditional business models - Platform-based business models - Servitization and product-service systems - Data-driven business models - Collaborative and sharing economy models
Week 7-8	**Application Areas of Networked Systems** - Smart manufacturing and Industry 4.0 - Smart cities and urban infrastructure - Connected healthcare systems - Intelligent transportation systems - Smart grids and energy management - Agriculture and environmental monitoring
Week 9-10	**Core Competencies for Networked Systems** - Data analytics and interpretation - Network design and optimization - Cybersecurity and risk management - Systems integration and interoperability - Human-machine interaction and user experience design - Ethical considerations in networked systems
Week 11-12	**Technology Roadmaps for Networked Systems** - Principles of technology roadmapping - Emerging technologies in networked systems (5G/6G, AI, blockchain, etc.) - Forecasting technological trends - Aligning technology development with business strategy - Creating and presenting technology roadmaps
Week 13	**Final Project Presentations**

Tentative Schedule (changes tba)

Academic Integrity and Student Responsibility

The lecturer appreciates a substantial exchange between the students, because the fellow students may have valuable contributions to the comprehension of occurring problems or questions.

Following the arguments, collaboration and also an autonomous exercise solving or the discussions on upcoming questions within the lectures are fundamental for a clearer understanding of the subject matter.

Large class sizes and foreign languages imply a risk of a high noise level, which has a strong negative influence on the work climate, knowledge acquisition and collaboration. Predominantly, a high noise level is caused by a few group members. These ‘troublemakers’ hinder the other ones

from being able to concentrate and therefore won't be tolerated and will be ejected from the class.

Code of Conduct for Students

Link to the Code of Conduct for online Teaching

Teaching Philosophy

My aim is to ensure that you have a successful learning progress and an understanding of the practical importance of the learning content. When you don't understand a learning step, you should pose a question during the lesson. I want to support every student who is committed to take the required knowledge and to pass the exams successfully.

Additional Information

Further details to be announced via e-learning (sign in and check regularly!)

Language: English