

Module Title:	Manufacturing Methods Industry 4.0 and Internet of Things	
Module No.: DLMBMMIT	Semester / Term: --	Duration: Minimum 1 Semester
Module Type(s): Wahlpflicht	Regularly offered in: WS, SS	
Workload: 300 h	Credit Points: 10	
Admission Requirements: None	Language of Instruction: Englisch	
Contributing Courses to Module: <ul style="list-style-type: none"> • Internet of Things (DLMBMMIT01) • Manufacturing Methods Industry 4.0 (DLMBMMIT02) 	Workload: Self-study: 180 h Self-examination: 60 h Tutorials: 60 h	
Course Coordinator(s) / Tutor(s): Please see the current list of tutors on the Learning Management System.	Module Director: Dr. Marian Benner-Wickner	
References to Other Programs: <ul style="list-style-type: none"> • Master of Business Administration 	References to Other Modules in the Program: <ul style="list-style-type: none"> • Corporate Finance 	

Qualification and Educational Objectives of the Module:

Manufacturing Methods Industry 4.0:

Upon successful completion of this course, students will be able to:

- evaluate different manufacturing methods against given product and process requirements.
- define and design modern additive techniques in contrast to traditional manufacturing.
- assess and estimate the impact of current trends on manufacturing like cyber-physical systems to given manufacturing challenges and practical problems.
- apply modern processes like rapid prototyping, rapid tooling, and direct manufacturing.

Internet of Things:

Upon successful completion, students will be able to:

- distinguish and discuss a broad range of use cases for the internet of things (IoT).
- deeply understand and reflect the different perspectives on the internet of things.
- apply distinct techniques to engineer internet of things products.
- evaluate and identify appropriate IoT communication technology and standards according to given IoT product requirements.
- reflect on the resp. theoretical foundation, evaluate different approaches and apply adequate approaches on practical questions and cases.

Course Content of the Module:

Manufacturing Methods Industry 4.0:

- Traditional manufacturing processes like forming and cutting as well as modern processes like rapid prototyping, rapid tooling, and direct manufacturing

Internet of Things:

- Consumer use cases and risks
- Business use cases and risks
- Social-economic issues
- Enabling technologies and networking fundamentals

Teaching Methods:	See the contributing course outlines	
Literature:	See the contributing course outlines	
Percentage of the Module Grade Relative to the Final Grade for the Program: --	Prerequisites to Qualify for Assessment:	Assessment:
	See course outlines	Module Exam, 180 min (100%)

Course No.: DLMBMMIT01	Course Title: Internet of Things	Hours Total: 150 h
		Credit Points: 5 ECTS
Course Type: Wahlpflicht Course Availability: Course Duration: Minimum 1 Semester	Admission Requirements: None	
Course Coordinator / Instructor: See current list of tutors in the Learning Management System	References to Other Modules: Please see module description	

Course Description:

The Internet of Things, once a rough vision, today becomes reality in a broad manner. There is a plethora of devices and services available to both consumer and businesses. From smart homes to smart cities, from smart devices to smart factories – internet of things technologies impact on our live and environment.

This course follows a top-down approach, discussing a broad set of aspects connected with the internet of things. It starts with use cases and risks from customer and business perspectives and ends up with the technical foundation of the internet of things. To address the engineering perspective, a set of techniques is proposed.

Course Objectives and Outcome:

Upon successful completion of the course, students will be able to:

- distinguish and discuss a broad range of use cases for the internet of things (IoT).
- deeply understand and reflect the different perspectives on the internet of things.
- apply distinct techniques to engineer internet of things products.
- evaluate and identify appropriate IoT communication technology and standards according to given IoT product requirements.
- reflect on the resp. theoretical foundation, evaluate different approaches and apply adequate approaches on practical questions and cases.

Teaching Methods:

The learning materials include printed and online course books, vodcasts, online knowledge tests, podcasts, online tutorials, and case studies. This range of learning materials is offered to students so they can study at a time, place, and pace that best suits their circumstances and individual learning style.

Course Content:

- 1. Introduction Into the Internet of Things**
 1. Foundations and Motivation
 2. Evolution of the Internet
- 2. Social and Business Relevance**
 1. Innovations for Consumers and Industry
 2. Impact on Human and Work Environment
 3. Privacy and Security
- 3. Communication Standards and Technologies**
 1. Network Topologies
 2. Network Protocols
 3. Technologies
- 4. Data Storage and Processing**
 1. Linked data and RDF(S)
 2. Semantic Reasoning
 3. Complex Event Processing
 4. NoSQL and MapReduce
- 5. Design and Implementation**
 1. Software Engineering for Distributed and Embedded Systems
 2. Architectural Styles and Patterns
 3. Platforms
- 6. Fields of Application**
 1. Smart Home/Living
 2. Ambient Assisted Living
 3. Smart Energy/Grid
 4. Smart Factory
 5. Smart Logistics

Literature:

- Chaouchi, H. (2013). The Internet of Things: Connecting Objects. London: Wiley.
- Greengard, S. (2015). The Internet of Things. Cambridge, Massachusetts: MIT Press.
- Kellmerein, D. & Obodovski, D. (2013). The Silent Intelligence: The Internet of Things. San Francisco: DND Ventures.
- Slama, D., Puhlmann, F., Morrish, J., & Bhatnagar, R. M. (2016). Enterprise IoT: Strategies and Best Practices for Connected Products and Services. Beijing, Boston, Farnham, Sebastopol, Tokyo: O'Reilly.
- Weber, R. H., & Weber, R. (2010). Internet of Things: Legal Perspectives. Berlin, Heidelberg: Springer-Verlag. <http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10395432>.

An actual list with course-specific mandatory reading as well as references to further literature is available in the Learning Management System.

Examinations:

- Exam, 90 min.

Student Workload (in hours): 150

Self-study: 90 h

Self-examination: 30 h

Tutorials: 30 h

Course No.: DLMBMMIT02	Course Title: Manufacturing Methods Industry 4.0	Hours Total: 150 h
		Credit Points: 5 ECTS
Course Type: Wahlpflicht Course Availability: Course Duration: Minimum 1 Semester		Admission Requirements: None
Course Coordinator / Instructor: See current list of tutors in the Learning Management System		References to Other Modules: Please see module description
<p>Course Description:</p> <p>The aim of the course is to enable students to evaluate and identify appropriate manufacturing methods in the context of Industrie 4.0. For that purpose, the course provides a comprehensive introduction of such processes based on traditional, standardized manufacturing techniques that have influenced and are still influencing production processes through technological developments under the generic term Industrie 4.0. These include, in particular, technological advances in additive manufacturing processes that enable applications such as rapid prototyping, rapid tooling and direct manufacturing. Finally, the course deals with the consequences of the digitization and networking of production facilities and their elements in terms of a cyber-physical system.</p> <p>Course Objectives and Outcome:</p> <p>Upon successful completion of this course, students will be able to:</p> <ul style="list-style-type: none"> • evaluate different manufacturing methods against given product and process requirements. • define and design modern additive techniques in contrast to traditional manufacturing. • assess and estimate the impact of current trends on manufacturing like cyber-physical systems to given manufacturing challenges and practical problems. • apply modern processes like rapid prototyping, rapid tooling, and direct manufacturing. <p>Teaching Methods:</p> <p>The learning materials include printed and online course books, vodcasts, online knowledge tests, podcasts, online tutorials, and case studies. This range of learning materials is offered to students so they can study at a time, place, and pace that best suits their circumstances and individual learning style.</p> <p>Course Content:</p> <ol style="list-style-type: none"> 1. Introduction into Manufacturing Methods <ol style="list-style-type: none"> 1. Basic Concepts 2. Historical Development of Manufacturing 3. About the Long Tail 2. Manufacturing Methods <ol style="list-style-type: none"> 1. Casting 2. Shaping 3. Cutting 4. Joining 5. Coating 		

6. Moulding
3. **Additive Manufacturing**
 1. Basics and Legal Aspects
 2. Stereolithography
 3. Selective Laser Sintering
 4. Fused Deposition Modeling
 5. Multi-Jet Modeling
 6. 3D Printing
 7. Laminating
 8. Selective Mask Sintering
4. **Rapid Prototyping**
 1. Definitions
 2. Strategical and Operative Aspects
 3. Application Scenarios
5. **Rapid Tooling**
 1. Definitions
 2. Direct and Indirect Methods
6. **Direct/Rapid Manufacturing**
 1. Potentials and Requirements
 2. Implementation Examples
7. **Cyber-Physical Production Systems**
 1. Concepts
 2. Cyber-Physical Systems
 3. Cyber-Physical Production Systems
 4. Impact on Design and Maintenance of Plants
 5. Dynamic Reconfiguration and Migration of Plants

Literature:

- Gad, S. (2008): Implementing IT Governance: A Practical Guide to Global Best Practices in IT Management. Van Haren Publishing.
- Anderson, C. (2012). Makers. The New Industrial Revolution. New York: Crown Business.
- Gebhardt, A. (2012). Understanding Additive Manufacturing. Rapid Prototyping – Rapid Tooling – Rapid Manufacturing. München/Cincinnati: Hanser.
- Groover, M. P. (2012). Fundamentals of Modern Manufacturing: Materials, Processes, and Systems. John Wiley & Sons Inc.

An actual list with course-specific mandatory reading as well as references to further literature is available in the Learning Management System.

Examinations:

- Exam, 90 min.

Student Workload (in hours): 150

Self-study: 90 h
 Self-testing: 30 h
 Tutorials: 30 h