HS PF

MODULE HANDBOOK

Master of Science
Industrial Management (MIM)

HS PF Engineering

Head of programme:
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The original document is the binding version.

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Note on the modules:
The modules usually last one semester. The "Semester" section indicates the respective semester. If a module spans two consecutive semesters, both semesters are indicated in the above section. Admission is generally planned for the winter semester and the summer semester. However, the subjects are only offered once a year. The two subject semesters 1 and 2 can therefore also be completed in reverse order.
The Master's programme in Industrial Management offers a purely English-language specialisation (MIM English Track), which is primarily aimed at applicants without sufficient German language skills. Up to six places are available for this programme. The English Track can only be started in the winter semester. In the English Track, a combination of English-language lectures from the MIM and English-language courses from the Master of Engineering and Management (MEM) programme enables students to complete 90 ECTS credits in English. For clarity, the range of subjects is presented as a separate section of this module handbook.
Examination performances are generally graded on a scale from 1 ("very good") to 5 ("unsatisfactory"). The exception to this are the courses marked as "ungraded examination" (UPL) in the special section of the study and examination regulations and in this module handbook. These are graded as "pass" or "fail", cf. § 24 (1, 2) SPO.

The courses (lectures and seminars) are designed for groups of 20-25 students.

Note on the scope of written work:
A Master's thesis typically comprises 70-100 pages. Project work typically comprises 40-60 pages, although other artefacts may also be defined in advance as the expected project outcome.

LIST OF ABBREVIATIONS

CP	Credit according to the ECTS system (1 CP corresponds to 25-30 hours
of work.	
	this document, the workload calculations are based on the maximum possible workload. They may also be be correspondingly lower.)
ECTS	European Credit Transfer and Accumulation System
PLH	Examination performance Term paper
PLK	Examination performance written examination
PLM	Oral examination
PLP	Examination performance Project work
PLR	Examination performance Presentation
PLS	Examination performance Term paper
PLT	Examination performance thesis
PVL	Preliminary examination
PVL-MP	Preliminary examination for the Master's examination
PVL-PLT	Preliminary examination for the thesis
STA1	First stage of studies
STA2	Second stage of study
SWS	Semester weekly hour(s)
UPL	Unmarked examination

I. Regular course of study MIM

1. Leadership

"Leadership"	
Reference number	MWI10029
Semester	1st semester
Level	Professional academic level
Credits	6
SWS	4
Related courses	MWI10030 Leading Virtual Teams MWI10031 Applied Leadership
Participation requirements according to SPO	Admission to the Master's programme
Recommended requirements	English B2
Examination type(s), examination duration (only for PLK/PLM)	PLH/PLK/PLP/PLR (60 minutes)
Language of instruction	English
Module coordinator	Prof. Dr. Jasmin Mahadevan
Lecturers	Leading Virtual Teams: Prof. Dr. Jasmin Mahadevan Applied Leadership: Prof. Dr. Cathrin Eireiner
Curriculum assignment	MIM – Compulsory subject, 1st semester
Teaching methods used in the module's courses	Lecture, seminar-style teaching, workshop, coaching, real-world project
Objectives	**Applied leadership:** Students • are familiar with the tasks and various roles of a manager • are familiar with various leadership concepts and their context dependency • have explored the mindset required in a leadership role • are aware of the relevance of personality and attitude in leadership tasks **Leading Virtual Teams:** Students • are aware of the importance of virtual teamwork as an increasingly relevant form of organisation and work and know when and how it should (not) be used • are familiar with the requirements for virtual team collaboration and know methods and ways to meet these requirements • can analyse and evaluate virtual team collaboration in a structured manner and derive situation- and case-specific criteria for 'good leadership' • are aware of the importance of self-leadership and leadership identity, as well as team-based and decentralised leadership for successful virtual team collaboration
Interdisciplinary Qualification goals	The module contributes significantly to personal development, in particular by strengthening the ability to reflect (on oneself), interact with other people/in a team and other social skills. This enables responsible leadership in the context of virtual, hybrid and non-virtual organisations.
Contents	**Applied leadership:** • Leadership tools • Leadership concepts • Leadership mandate and roles • Understanding leadership

	• Leadership mindset and leadership skills **Leading virtual teams:** • Fundamentals and forms of virtual team collaboration • Opportunities and risks of virtual teams • Special requirements for leadership in virtual teams • Special features of interdisciplinary, diverse, intercultural, flexible and/or global virtual teams • Key topics for successful leadership in virtual teams, e.g. cultural intelligence and intercultural competence; leadership identity and leadership styles; trust, learning and change; interaction and technology; diversity and dispersion, new forms of work (work-from-home, work-from-anywhere, flexible work arrangements, etc.)
Literature	**Applied leadership:** • Alznauer, M. (2016) Leading Naturally: The Evolutionary Source Code of Leadership. Springer. Frankfurt am Main. • McDonald, S.M. (2016) Leadership Attitude: How Mindset and Action can Change Your World. LeadershipHQ **Leading Virtual Teams:** • Mahadevan, J. (2024) Virtual Team Collaboration. Springer: Frankfurt am Main. • Further reading will be announced in the seminar
Workload	Workload: 6 ECTS x 30 hours = 180 hours Attendance time: 4 hours per week x 15 weeks = 60 hours.
Media	Slides, flipchart, projector, lectures in the form of presentations, case studies, active board, behavioural simulations, reflection

2. Networked Systems & Artificial Intelligence

"Networked Systems & Artificial Intelligence"	
Reference number	MWI10032
Semester	1st semester
Level	Professional academic level
Credits	6
SWS	4
Related courses	MWI10033 Applications of Artificial Intelligence MWI10034 Networked Systems – Fundamentals & Applications
Participation requirements according to SPO	Admission to the Master's programme
Recommended prerequisites	English B2
Examination type(s), examination duration (only for PLK/PLM)	PLH/PLK/PLP/PLR (60 minutes)
Language of instruction	English
Module coordinator	Prof. Dr Bernhard Kölmel
Lecturers	Applications of Artificial Intelligence: Prof. Dr. Raphael Volz Networked Systems – Fundamentals & Applications: Prof. Dr Bernhard Kölmel
Curriculum assignment	MIM – Compulsory subject, 1st semester
Teaching methods used in the module's courses	Lecture, seminar-style teaching
Objectives	**Applications of artificial intelligence:** • The aim of this course is to give students an understanding of the various applications of artificial intelligence (AI). Basic concepts and techniques of AI are introduced and explained using concrete application examples. • Students will learn how AI algorithms and models can be used in various areas such as image recognition, language processing, data analysis and decision-making. They will become familiar with the relevant AI methods and tools for developing, implementing and evaluating these applications. • Another goal is to make students aware of the ethical and social aspects of AI applications. They should understand the impact AI systems can have on privacy, the labour market, social justice and other areas, and how these aspects should be taken into account when developing and implementing AI applications. **Networked Systems – Fundamentals & Applications:** • The main objective of this course is to provide students with a basic understanding of networked systems. It covers the fundamental concepts, technologies and protocols for communication and interaction between networked devices and systems. • Students will develop an understanding of how networked systems are used in various application areas such as the Internet of Things (IoT), smart cities, Indus-

	try 4.0 and smart homes. They will learn how these systems are designed, implemented and operated, including aspects such as network topologies, protocols, security and data management. • Another goal is to teach students the importance and challenges of interoperability and scalability in networked systems. They will learn how different components and devices can communicate and work together, as well as understand the possibilities and limitations of these systems in order to develop effective and reliable applications.
Interdisciplinary qualification goals	• Systemic thinking: One interdisciplinary qualification goal is to develop the ability to think systemically. This involves understanding complex relationships and interactions between different disciplines, fields and actors. Systemic thinking enables complex problems to be analysed holistically and comprehensive solutions to be developed that transcend the boundaries of individual disciplines. • Innovation and creativity: Another goal is to promote innovation and creativity through the exchange and integration of knowledge from different disciplines. By combining different perspectives and ideas, innovative approaches and solutions can be developed. Interdisciplinary collaboration makes it possible to break through conventional patterns of thinking and find new ways to tackle complex problems. • Ethics and sustainability: An important qualification goal is to raise awareness of ethical and sustainability issues. Interdisciplinary collaboration requires consideration of social, environmental and economic impacts. Students should recognise the ethical implications of their actions and be able to develop sustainable solutions that have long-term positive effects. • Science communication: Another goal is to develop the ability to communicate complex scientific content effectively across disciplinary boundaries. Students should be able to present their knowledge and research findings in a clear and understandable way, both to experts and to a wider audience. Clear and convincing communication can help to successfully communicate interdisciplinary projects and facilitate collaboration with experts from other disciplines.
Contents	**Applications of Artificial Intelligence:** 1. Introduction to artificial intelligence: The course begins with a basic introduction to the field of artificial intelligence. Students learn about the concepts, goals and applications of AI. 2. AI algorithms and models: Various AI algorithms and models are presented, including machine learning, neural networks, decision trees, genetic algorithms and more. Students learn how these algorithms work and what applications they have. 3. Applications of AI: The course covers specific examples of artificial intelligence applications. These include areas

	such as image recognition, speech processing, automated decision-making, robotics, autonomous vehicles and many others. 4. Data analysis and pre-processing: Since AI is heavily dependent on data, students learn how to analyse, pre-process and prepare data for AI applications. Topics such as data cleaning, feature extraction, dimension reduction and data visualisation are covered. 5. Ethics and responsibility: The course also covers the ethical and social aspects of artificial intelligence applications. Students learn to identify and discuss ethical issues related to data protection, discrimination, trust and transparency. It also discusses how AI systems can be developed and used responsibly. **Networked Systems – Fundamentals & Applications:** 1. Introduction to Networked Systems: The course begins with an introduction to the fundamentals of networked systems. Students learn about the concepts, principles and technologies behind the networking of devices and systems. 2. Network architectures and protocols: Various network architectures such as client-server, peer-to-peer and cloud computing are covered. In addition, the most important network protocols such as TCP/IP, HTTP, MQTT and others are introduced and their applications explained. 3. Internet of Things (IoT): One focus is on the Internet of Things, an important area of application for networked systems. Students learn the basics of IoT, including sensor technologies, connectivity, data management and areas of application such as smart homes, wearables and Industry 4.0. 4. Security and data protection: In view of increasing networking and data exchange, security and data protection aspects are also covered. Students learn the basic principles of network security, encryption techniques, access controls and data protection regulations to protect networked systems from threats. 5. Applications and case studies: The course also includes the examination of specific applications and case studies of networked systems. This may include smart cities, intelligent transport systems, health technologies or other areas. Students gain insights into real-world applications and discuss the challenges, opportunities and impacts of networked systems in various areas.
Literature	**Applications of Artificial Intelligence:** • Russell, S., & Norvig, P. (2016). *Artificial Intelligence: A Modern Approach* (3rd ed.). Pearson. • Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning.* MIT Press. • Murphy, K. P. (2012). *Machine Learning: A Probabilistic Perspective*. MIT Press. • Bishop, C. M. (2006). *Pattern Recognition and Machine Learning.* Springer. • **Networked Systems – Fundamentals & Applications:**

	• Ray, P. P. (2021). *Internet of Things: A Hands-On Approach* (2nd ed.). Springer. • Li, S., Da Xu, L., & Zhao, S. (2020). *Internet of Things for Industry 4.0: Design, Technologies, and Applications.* CRC Press. • Yan, Z., Zhang, P., & Vasilakos, A. V. (Eds.). (2020). *Internet of Things: Principles and Paradigms*. Wiley. • Misra, S., Agarwal, P. K., & Mahadevappa, V. G. (Eds.). (2020). *Handbook of Research on IoT and Big Data Technologies for Enterprises.* IGI Global.
Workload	Workload: 6 ECTS x 30 hours = 180 hours Attendance time: 4 hours per week x 15 weeks = 60 hours 120 hours of preparation/follow-up work for lectures and exam preparation.
Media	Lectures with discussion, case studies with seminar exercises in small groups

3. Research methods & innovation

Research Methods & Innovation	
Reference number	MWI10007
Semester	1st semester
Level	Vocational academic level
Credits	6
SWS	4
Related courses	MWI10008 Research Methods MWI10009 Product Strategy/Product Development
Participation requirements according to SPO	Admission to the Master's programme
Recommended requirements	English B2
Examination type(s), examination duration (only for PLK/PLM)	PLH/PLR/PLK (60 minutes)
Language of instruction	German or English
Module coordinator	Prof. Dr Ludwig Martin
Lecturers	Research methods: Prof. Dr Ludwig Martin Product strategy/product development: Prof. Dr. Henning Hinderer/Prof. Dr. Rainer Wunderlich
Curriculum assignment	MIM, MEM – Compulsory subject 1st semester
Teaching methods used in the module's courses	Seminar-based teaching and exercises, block course with follow-up sessions, project
Objectives	**Research methods:** Students are familiar with the variety of research approaches and can classify them in terms of scientific theory. Based on specialist knowledge of common qualitative and quantitative methods, students can design (smaller) research projects and draw up project plans. Students can identify related ethical issues and formulate solutions. In addition, they can critically evaluate and classify their own results as well as those of others, also with regard to the methodology and methods used. Students are aware of the interdisciplinary nature of the programme in terms of research approaches and know how to deal with this, including in terms of the admissibility of different perspectives and creative problem solving. By combining this with specialist knowledge from the elective modules of the programme, they can also classify their own contributions in terms of subject matter. **Product strategy/product development:** After a methodological introduction to the areas of strategic product planning, creativity methods and methods of market-oriented product development, students are able to systematically develop a new product from the idea to marketing. Important components are the creative generation of ideas and the derivation of the contents of a suitable business model and a market launch strategy. In small groups, students develop their own product idea, which is to be implemented as a prototype for a planned market launch. There is the option of supporting the product ideas with a business plan in further modules, e.g. IDP or Master's thesis.
Interdisciplinary Qualification objectives	The module contributes to the further development of students' understanding of methods and the development and marketing

	of products. The connection between the application and understanding of methods (research and product development) and the corresponding results is taught. This also applies to the evaluation of areas of application of methods and their limitations.
Contents	**Research methods:** The prevailing paradigms of knowledge acquisition are explained and distinguished from one another. Various approaches and related methodologies are explained through a research problem-oriented introduction to the topic. Engineering and social science (including business research) approaches and related methods are introduced, explored in depth and discussed using exercises and case studies. With reference to empirical research, questions regarding the validity and reliability of various methods and approaches are discussed. Questions of scientific ethics are explored and solutions are developed using examples. Basic forms of good scientific practice (e.g. declarations of consent in surveys, avoidance of plagiarism, dealing with generative AI) are covered. The procedure for classifying one's own contribution within existing knowledge (state of the art/state of science) is explained and practised. Source work and the critical processing of what has been read into one's own texts is demonstrated and consolidated through exercises. **Product strategy/product development:** Methods of strategic product planning and market-oriented product development are explained, discussed and used experimentally with the aim of preparing a strategic and market-oriented development of a product based on one's own idea. Strategic product planning: • Approaches to agile product development (scenario building, design thinking approaches, BMC) • Practical application of strategic methods in the context of product design Approaches to idea generation: • Analysis of trends and innovative technologies as approaches to idea generation • Design thinking and other creativity methods Methods of market-oriented product development: • Product development methods • Market research and testing methods • Market launch strategy with communication plan
Literature	**Research methods:** • Leedy, P. D., Ormrod, J. E. (2016): *Practical Research: Planning and Design.* 11th Edition, Pearson. • Bryman, A., Bell, E. (2015): *Business Research Methods*. 4th Edition, Oxford University Press: Oxford. • Kornwachs, K. (2010): *Technological Knowledge – Origin, Methods, Structures.* Acatech/Springer: Berlin. (PDF available online) Lindenlauf, F. (2022): *Scientific Work in Engineering and Natural Sciences*. Springer Spektrum: Berlin. • Various texts provided on e-learning **Product strategy/product development:** • Porter, M. E. (2013): *Competitive Strategies*. 12th edition, Campus: Frankfurt/Main.

	• Lewrick, M., Link, P., Leifer, L. (2018): *The Design Thinking Playbook.* 2nd edition, Vahlen: Munich. • Osterwalder, A., Pigneur, Y. (2011): *Business Model Generation*. Campus: Frankfurt/Main. • Gerstbach, I. (2016): *Design Thinking in Business. A workbook for introducing design thinking*. Gabal: Offenbach. • Bland, D. J., Osterwalder, A., Smith, A., & Papadakos, T. (2020). *Testing business ideas*: Wiley: Hoboken. • Ulrich, K. T., Eppinger S. D. (2012): *Product design and development.* 5th Edition, McGraw-Hill: New York.
Workload	Workload: 6 ECTS x 30 hours = 180 hours. Attendance time: 4 hours per week x 15 weeks = 60 hours
Media	PowerPoint, handouts, interactive group tasks, individual tasks, interactive teaching discussions, research work (including library), discussion of models and designs.

4.

"Interdisciplinary Innovation/Research Project"	
Reference number	MWI10010
Semester	1st/2nd semester
Level	Vocational academic level
Credits	9
SWS	6
Related courses	MWI10011 Innovation/Research Project Design MWI10012 Innovation/Research Project Implementation
Participation requirements according to SPO	Admission to the Master's programme
Recommended prerequisites	Parallel participation in the courses MWI10008 Research Methods and MWI10009 Product Strategy/Product Development
Examination type(s), examination duration (only for PLK/PLM)	PLP in each case
Language of instruction	German or English
Module coordinator	Prof. Dr. Ansgar Kühn
Lecturers	Innovation/research project design: all lecturers in the Industrial Engineering department Innovation/research project implementation: all lecturers in the Industrial Engineering department
Assignment to the curriculum	MIM, MEM – Compulsory subject 1st/2nd semester
Teaching methods used in the module's courses	Project in small groups (4 people) with intensive supervision by a teacher across both courses
Objectives	Students are familiar with the diversity of research approaches and can classify them in terms of scientific theory and apply them in specific projects. They are also familiar with a variety of innovation methods. Based on specialist knowledge of common qualitative and quantitative methods, students can design (smaller) research/innovation projects and implement them in prototype form to clarify relevant issues. Students can identify any associated ethical issues and develop solutions. In addition, they can critically evaluate and classify their own results as well as those of others, also with regard to the methodology and methods used. Students are aware of the interdisciplinary nature of the programme in terms of innovation and research approaches and know how to deal with this, including in terms of the admissibility of different perspectives and creative solution finding, and feedback from stakeholders in a target market. By combining this with specialist knowledge from the compulsory and elective modules of the programme, they can also classify their own contributions in technical terms. Students can develop, adequately document and present solutions in an innovation project/research project (also in collaboration with external companies). This also includes the possibility of publishing the work or its results.
Interdisciplinary qualification goals	The module contributes to management skills, teamwork and project management skills. It strengthens the ability for critical reflection and creative problem-solving.

Contents	Possible research/innovation projects are presented by various lecturers at the beginning of the module. The research/innovation projects can be of different natures and involve a wide variety of problems. • The lecturers teaching the elective modules specify the topics of the research/innovation project, which can also be carried out in collaboration with external companies. • The problems are always solved on a scientific basis and the project documentation is written as a scientific paper or as product documentation in a suitable form (drawing, parts list, product description, manual, etc.). • Ideally, the project work concludes with a scientific paper worthy of publication or a concrete and detailed product/business idea, including a functional prototype if possible. The lecturers are available to the students as mentors. **Innovation/research project concept:** The prevailing paradigms of knowledge acquisition are explained and distinguished from one another. Various approaches and related methodologies are explained through a research problem-oriented introduction to the topic. Engineering and social science (including business research) approaches and related methods are introduced and discussed in depth using exercises and case studies. With reference to innovation and application-oriented development, all aspects of product development are discussed – this includes methods of market research and target group analysis, documentation and validation of requirements, and an iterative approach to the project. In projects involving empirical research, questions regarding the validity and reliability of various methods and approaches are also discussed. **Innovation/research project implementation:** Building on the knowledge gained in the Innovation/Research Project Design course, students work on a research/innovation project and produce a coherent documentation of their work. In innovation projects, market and user feedback should be determined using functional prototypes wherever possible and taken into account in further development.
Literature	**Innovation/Research Project Design:** • Leedy, P. D., Ormrod, J. E. (2016): *Practical Research: Planning and Design.* 11th Edition, Pearson. • Bryman, A., Bell, E. (2015): *Business Research Methods*. 4th Edition, Oxford University Press: Oxford. • Kornwachs, K. (2010): *Technological Knowledge – Origin, Methods, Structures.* Acatech/Springer: Berlin. (PDF available online) • Großklaus, Rainer H. G. (2014): *From Product Idea to Market Success: Planning, Introducing and Successfully Managing Innovations.* - 2nd edition 2014. - Wiesbaden: Gabler Verlag, 2014. • Further reading as required **Innovation/research project implementation:** • • Bland, D. J., Osterwalder, A., Smith, A., & Papadakos, T. (2020). *Testing business ideas*: Wiley: Hoboken. • Engeln, Werner (2006): *Methods of Product Development*. Munich: Oldenbourg-Industrieverlag.

	• Schwarz, Erich J.; Dummer, Rita; Krajger, Ines (2007): *From Business Idea to Market Success*. Vienna: Linde Verlag • Subject-specific literature depending on the respective project work.
Workload	Workload: 9 ECTS x 30 hours = 270 hours. Innovation/research project concept: 3 ECTS Innovation/research project implementation: 6 ECTS Attendance time: 6 hours per week x 15 weeks = 90 hours or attendance time in consultation with supervisor/depending on project
Media formats	Depending on the respective project work/supervisor: PowerPoint, handouts, interactive group tasks, physical or IT-based prototypes, interactive teaching discussions, research work (library).

5. Elective subjects "Focus"

Subjects worth 9 ECTS credits must be selected from the Master's programmes offered by the WI department and/or other departments/faculties of the university in consultation with the programme director and the respective lecturer. Subjects must be reported to the Examination Office either by list or, if necessary, individually by form.

Individual courses can be combined individually, or entire elective modules can be taken. There is no guarantee that there will be no overlap. A list of the elective subjects and modules available in the programme can be viewed at the programme director's office.

"Elective subjects "Focus"" / "Electives "Focus""	
Reference number	MWI10023
Semester	1st/2nd semester
Level	Vocational academic level
Credits	9
SWS	6
Related courses	MWI10024 Focus A MWI10025 Focus B MWI10026 Focus C
Participation requirements according to SPO	Admission to the Master's programme
Recommended requirements	Technical and organisational questions, especially for Master's courses that are not run by the WI department, must be clarified with the lecturer in advance.
Examination type(s), examination duration (only for PLK/PLM)	PLH/PLK/PLP/PLR (exam duration according to elective list)
Language of instruction	German or English
Module coordinator	Prof. Dr. Ansgar Kühn
Lecturers	The respective lecturers of the selected Master's courses on the elective list.
Assignment to the curriculum	MIM, MEM – compulsory elective subject 1st/2nd semester
Teaching methods used in the module courses	Depending on the selected courses, seminar-style teaching, lectures or projects.
Objectives	Students acquire additional, in-depth knowledge within the framework of specialisation subjects of their own choice. The wide range of Master's courses offered by Pforzheim University gives students the opportunity to set their own individual priorities.
Interdisciplinary Qualification goals	Depending on the selected courses
Contents	These depend on the selected courses from the elective list. Courses can be selected from the Master's programmes offered by all three faculties of the university in consultation with the programme director and the respective lecturer. The subjects that can be selected are listed in a list (selection list). Courses can be combined individually or taken as entire elective modules. There is no entitlement to admission or freedom from overlap.
Literature	This depends on the selected courses from the elective list.
Workload	Workload: 9 ECTS x 30 hours = 270 hours

	Attendance time: 6 hours per week x 15 weeks = 90 hours attendance time
Media formats	Depending on the selected courses.

6. Major Industrial Management I

"Major Industrial Management I"	
Reference number	MWI10045
Semester	1st/2nd semester
Level	Vocational academic level
Credits	6
SWS	4
Related courses	MWI10046 Seminar Industrial Management A MWI10047 Seminar Industrial Management B
Participation requirements according to SPO	Admission to the Master's programme
Recommended requirements	English B2
Examination type(s), examination duration (only for PLK/PLM)	PLH/PLK/PLP/PLR respectively (60 minutes)
Language of instruction	Seminar Industrial Management A: English Seminar Industrial Management B: German or English
Module coordinator	Prof. Dr. Ansgar Kühn
Lecturers	Seminar Industrial Management A: TBD Seminar Industrial Management B: TBD
Curriculum assignment	MIM – Compulsory subject 1st/2nd semester
Teaching methods used in the module's courses	Seminar/lecture/workshop
Objectives	Students acquire in-depth knowledge and skills to enable effective management in industrial organisations. To this end, the module teaches both theoretical principles and practical application to enable students to take on various management tasks in a complex, technically oriented environment. In particular, students learn about the special requirements of selected complex and interdisciplinary issues and are able to develop convincing solutions. Where possible, the module is designed to take into account the students' initial qualifications, thus enabling targeted knowledge transfer.
Interdisciplinary Qualification goals	The module strengthens critical reflection and problem-solving skills as well as interdisciplinary competencies.
Contents	The field of industrial management covers a wide range of topics. In addition to the topics covered in other modules, additional topics can be specifically included or explored in greater depth in the Industrial Management I major. This includes, among other things: • Strategy and organisation: aspects of structural and procedural organisation, industry, competition and market analysis, strategy development and strategic planning • Operations management: Principles and tools for the effective management of industrial operations processes. This includes process improvement, supply chain management, quality control and productivity improvement methods. • HR management: Management of HR in an industrial environment in all aspects throughout the HR lifecycle

	• Financial management: Special emphasis on decision-making and resource allocation, analysis, budgeting, controlling, investment decisions, risk assessment. • Sustainability & Resilience: Integration of sustainable and environmentally friendly working methods and processes in manufacturing companies. CSR, sustainable and resilient supply chains, energy management, circular economy, green manufacturing
Literature	To be announced by the lecturer.
Workload	Workload: 6 ECTS x 30 hours = 180 hours Attendance time: 4 hours per week x 15 weeks = 60 hours
Media	PowerPoint, flipchart, practical lecture

7a. Major Engineering

Depending on the proven entry qualification, one of the modules 7a, 7b or 7c must be completed:
- 7a for students without a relevant technical bachelor's degree;
- 7b for students with a technical bachelor's degree;
- 7c for students who can demonstrate both technical and commercial entry qualifications from their bachelor's degree, e.g. by comparison with the WI qualification framework; in this case, subjects worth 6 ECTS must be taken.

The 7a/7b/7c classification is determined after individual review by the programme director as part of a binding study agreement.

<table>
<tr><td colspan="2">"Major Engineering"</td></tr>
<tr><td>Reference number</td><td>MWI10060</td></tr>
<tr><td>Semester</td><td>1st/2nd semester</td></tr>
<tr><td>Level</td><td>Vocational academic level</td></tr>
<tr><td>Credits</td><td>6</td></tr>
<tr><td>SWS</td><td>4</td></tr>
<tr><td>Related courses</td><td>MWI10049 Engineering Fundamentals
MWI10061 Fundamentals of Industrial Production</td></tr>
<tr><td>Participation requirements according to SPO</td><td>Admission to the Master's programme</td></tr>
<tr><td>Recommended requirements</td><td>English B2</td></tr>
<tr><td>Examination type(s), examination duration (only for PLK/PLM)</td><td>PLH/PLK/PLP/PLR respectively (60 minutes)</td></tr>
<tr><td>Language of instruction</td><td>Engineering fundamentals: English
Fundamentals of Industrial Production: German or English</td></tr>
<tr><td>Module coordinator</td><td>Prof. Dr. Kai Oßwald</td></tr>
<tr><td>Lecturers</td><td>Engineering Fundamentals: Prof. Dr. Kai Oßwald
Fundamentals of Industrial Production: Prof. Dr Herbert Emmerich</td></tr>
<tr><td>Curriculum assignment</td><td>MIM – Compulsory subject 1st/2nd semester</td></tr>
<tr><td>Teaching methods used in the module's courses</td><td>Seminar-style lecture with practical exercises</td></tr>
<tr><td>Objectives</td><td>Engineering fundamentals:
• Teaching the fundamentals of technical communication
• Practising engineering calculations
• Introduction to fundamental engineering subjects

Fundamentals of industrial production:
• Introduction to the most basic manufacturing processes
• Introduction to modern production methods
• Fundamentals of automated manufacturing</td></tr>
<tr><td>Interdisciplinary qualification objectives</td><td>The module teaches the most essential technical fundamentals for students with little or no technical background. This lays the groundwork for the technical subjects in the degree programme.</td></tr>
<tr><td>Contents</td><td>Engineering fundamentals:
• Fundamentals (1 unit)
    o Calculations
        ▪ Fundamentals
        ▪ Examples
        ▪ Fermi problems
    o Units
• Technical drawing (2 units)</td></tr>
</table>

	- Descriptive geometry, projections, views - Threads, dimensions - Exercises • Technical mechanics (3 units) - Forces and torques (central and general force systems) - Stress and strength • Materials science (4 units) - Metals: lattices, crystallites, dislocations, iron-carbon diagram - Fundamentals of polymers ▪ Formation and behaviour ▪ Basic manufacturing processes • Electrical engineering (4 units) - Direct current ▪ Resistance, Kirchhoff's laws - Alternating current ▪ Transformers - Three-phase current - Power, energy - Digital technology - Calculating electrical quantities **Fundamentals of industrial production:** • Manufacturing processes (5 units) - Primary forming - Forming - Cutting - Joining • Production and assembly methods (2 units) - TPS - 5S - … • Automation (5 units) - PLC and CNC - Components of automated machines - Industry 4.0 - ... • Production measurement technology and quality (3 units) - Tolerances - Measuring and testing - Quality and quality management
Literature	**Engineering Fundamentals:** OBERG, Erik. *Machinery's Handbook, Toolbox & Calc Pro 2 Combo*. 2016. **Fundamentals of Industrial Production:** BENDER, Beate; GÖHLICH, Dietmar (eds.). *Dubbel Pocket-book for Mechanical Engineering Applications*. Springer Berlin, 2020.
Workload	Workload: 6 ECTS x 30 hours = 180 hours. Attendance time: 4 hours per week x 15 weeks = 60 hours
Media	Slide presentations, video, blackboard notes

7b. Major Business

Depending on the proven entry qualification, one of the modules 7a, 7b or 7c must be completed:

- 7a for students without a relevant technical bachelor's degree;
- 7b for students with a technical bachelor's degree;
- 7c for students who can demonstrate both technical and commercial entry qualifications from their bachelor's degree, e.g. by comparison with the WI qualification framework; in this case, subjects worth 6 ECTS must be taken.

The 7a/7b/7c classification is determined after individual review by the programme director as part of a binding study agreement.

"Major Business"	
Reference number	MWI10062
Semester	1st/2nd semester
Level	Academic level qualifying for professional practice
Credits	6
SWS	4
Related courses	MWI10051 Business Management MWI10063 Cost Accounting and Financing
Participation requirements according to SPO	Admission to the Master's programme
Recommended requirements	English B2
Examination type(s), examination duration (only for PLK/PLM)	PLH/PLK/PLM/PLR respectively (60 minutes)
Language of instruction	Business Management: English Cost Accounting and Finance: German or English
Module coordinator	Prof. Harald Schnell
Lecturers	Business Management: Prof. Harald Schnell Cost Accounting and Finance: Prof. Harald Schnell
Curriculum assignment	MIM – Compulsory subject 1st/2nd semester
Teaching methods used in the module's courses	Seminar-style teaching including a business simulation with workshop character (BM) and lectures with practical exercises (KR&Financing)
Objectives	**Business management:** In the form of a seminar with workshop character, students learn the thinking and behaviour of business people using a business simulation. Students learn how to manage a company commercially, analysing and ensuring effectiveness and efficiency within the company. Students learn how to use numerous commercial tools, such as market and SWOT analysis tools, product costing, cash flow accounting and the basics of accounting. **Cost accounting and financing:** In this lecture, students learn the basics of cost accounting with a focus on product costing, cost type accounting and cost unit accounting (income statement). In addition, the basics of corporate finance are taught, including capital requirements and investment planning as well as capital requirements coverage through various forms of financing.

Interdisciplinary Qualification objectives	In addition to the commercial expertise that forms the core of teaching in this subject, other goals and requirements that compete with commercial activity are discussed with students. This promotes ethical awareness in commercial enterprises. Furthermore, students learn to think beyond departments and functional areas in complex companies and to communicate and collaborate with each other in a variety of ways within the company.
Contents	**Business Management:** • Introduction to business administration: Setting goals – tapping into markets – ensuring profitability – securing financing – monitoring goals with key figures • Strategic planning: analysing strengths, weaknesses, opportunities and risks, analysing markets, aligning companies with the market • Tactical-operational business planning and budgeting (BP): content, structure, process, participants • Purchasing correctly and optimising logistics • Capacity and financial planning in the company • Pricing and calculation: basics of product cost determination • Measuring the achievement of business objectives using specific key figures, including EBIT, return on investment (ROI), break-even point, cockpit charts • Monitoring business development using the profit and loss statement, cash flow statement and balance sheet **Cost accounting and financing:** • Fundamentals of cost and performance accounting with cost unit accounting (product costing), cost type and cost centre accounting, and cost unit time accounting (income statement) • Fundamentals of financing with capital requirements and investment planning/budgeting as well as capital requirements coverage using equity and debt financing instruments.
Literature	• Charifzadeh, M.; Taschner, A.: Management Accounting and Control. Weinheim: Wiley – 2017 • Schnell, H.: Doing Business Management - Accompanying book to the lecture. – Can be downloaded from Moodle (e-learning). • Schnell, H.: Manual of the business simulation "Robert Wash Ltd." - Can be downloaded from Moodle (e-learning). • Horngren's cost accounting: a managerial emphasis / Srikant M. Datar (Harvard University), Madhav V. Rajan (Stanford University)
Workload	Workload: 6 ECTS x 30 hours = 180 hours Attendance time: 4 hours per week x 15 weeks = 60 hours
Media formats	**Business Management:** 9 units of traditional lectures with presentations and practical examples / 5 units of workshops using pinboards, flipcharts and a business simulation manual, plus a set of slides on the basics of business administration. **Cost accounting and financing:**

	Lecture/presentation, supplemented by numerous case studies, which are worked on in plenary sessions and/or in small groups.

7c. Major Industrial Management II

Depending on the proven entry qualification, one of the modules 7a, 7b or 7c must be completed:

- 7a for students without a relevant technical bachelor's degree;
- 7b for students with a technical bachelor's degree;
- 7c for students who can demonstrate both technical and commercial entry qualifications from their bachelor's degree, e.g. by comparison with the WI qualification framework; in this case, subjects worth 6 ECTS must be taken.

The 7a/7b/7c classification is determined after individual review by the programme director as part of a binding study agreement.

"Major Industrial Management II"	
Reference number	MWI10064
Semester	1st/2nd semester
Level	Vocational academic level
Credits	6
SWS	4
Related courses	MWI10053 Focus D MWI10066 Focus E
Participation requirements according to SPO	Admission to the Master's programme
Recommended requirements	Technical and organisational questions, especially for Master's courses that are not run by the WI department, must be clarified with the lecturer in advance.
Examination type(s), examination duration (only for PLK/PLM)	PLH/PLK/PLP/PLR (exam duration according to elective list)
Language of instruction	German or English
Module coordinator	Prof. Dr. Ansgar Kühn
Lecturers	The respective lecturers of the selected Master's courses from the elective list.
Assignment to the curriculum	MEM – Elective subject 1st/2nd semester
Teaching methods used in the module's courses	Depending on the selected courses, seminar-style teaching, lectures or projects.
Objectives	Students acquire additional, in-depth knowledge within the framework of specialisation subjects of their own choosing. The wide range of Master's courses offered by Pforzheim University gives students the opportunity to set their own individual priorities.
Interdisciplinary Qualification goals	Depending on the selected courses
Contents	These depend on the selected courses from the elective list. Courses can be selected from the Master's programmes offered by all three faculties of the university in consultation with the programme director and the respective lecturer. The subjects that can be selected are listed in a list (selection list). Courses can be combined individually or taken as entire elective modules. There is no entitlement to admission or freedom from overlap.
Literature	This depends on the selected courses from the elective list.
Workload	Workload: 6 ECTS x 30 hours = 180 hours.

	Attendance time: 4 hours per week x 15 weeks = 60 hours of attendance time
Media formats	Depending on the selected courses.

8. Technology Management and Negotiations

"Technology Management and Negotiations" / "Technology Management and Negotiations B-to-B"	
Reference number	MWI10067
Semester	2nd semester
Level	Professional academic level
Credits	6
SWS	4
Related courses	MWI10068 Technology and Innovation Management MWI10069 B-to-B Negotiation
Participation requirements according to SPO	Admission to the Master's programme
Recommended requirements	English B2
Examination type(s), examination duration (only for PLK/PLM)	Technology Management: PLH/PLR Negotiation: PLP/PLH/PLR
Language of instruction	German or English
Module coordinator	Prof. Dr. Moritz Peter
Lecturers	Technology and Innovation Management: TBD B2B Negotiation: Prof. Dr. Moritz Peter
Curriculum assignment	MIM – Compulsory subject, 2nd semester
Teaching methods used in the module's courses	Teaching of key concepts in lecture style, plus exercises and case studies, seminar-style teaching with project work
Objectives	**Technology and innovation management:** Students learn how practical technology and innovation management is structured, the scientific principles on which it is based, and which concepts and methods can be used in practice. This includes strategic planning, generating new ideas, evaluating them, selecting ideas and finally implementing them in marketable products and processes. **B-to-B negotiation:** After completing this course, participating students should: • demonstrate an in-depth understanding of the negotiation process within the context of a sourcing process/project, • be familiar with the most important negotiation strategies and tactics in the context of professional buying and selling, • be able to properly prepare, conduct and document negotiations as a buyer and/or seller, • understand how a negotiator can improve the outcome of a negotiation, even under difficult circumstances, • be able to respond to manipulation, conflict and threats without losing sight of the original objectives. After completing this course, students should be able to effectively prepare for and conduct negotiations and successfully conclude deals as professional buyers or sellers.
Interdisciplinary qualification goals	The module contributes to • students gain in-depth knowledge of the interrelationships involved in innovation development and implementation in companies. By working on practical examples, they enhance their systemic thinking skills by gaining an understanding of complex interrelationships and interactions between different disciplines, subject areas and actors. This

	increases their competence in holistically analysing complex problems relating to innovation development and implementation and their organisational implications in companies, and in developing comprehensive solutions that go beyond the boundaries of individual departments (R&D, sales, production, marketing, etc.) and disciplines (business administration, engineering, etc.). • Innovation and creativity are strengthened through the exchange and integration of knowledge from different disciplines in the course. By combining different perspectives and ideas, innovative approaches and solutions can be developed. Interdisciplinary collaboration makes it possible to break through conventional patterns of thinking and find new ways to tackle complex problems. • Students' ability to work in teams is enhanced (negotiating in groups) and entrepreneurial thinking is increased (negotiation goals and strategy).
Contents	**Technology and innovation management:** The focus is on identifying stimuli for innovation (taking into account open innovation approaches and cooperation with other organisations), dealing with and implementing innovative ideas in the company (evaluation, selection, technical implementation of ideas and market launch, as well as suitable processes) and a strategic view (taking into account megatrends and future scenarios). Furthermore, the role of business models in the development of innovations and the aspects to be considered in order to integrate sustainability as an important future topic into innovation management are presented. **B2B negotiation:** The course topics are based on the structure of an exemplary negotiation process in a B2B context. The course therefore covers the following content: • Pre-negotiation phase: Identifying your own interests and those of the other party; alternatives, strengths/weaknesses, etc. Developing a suitable negotiation strategy; assigning appropriate roles and tactics for the upcoming meetings (documented in a promising negotiation playbook) • Negotiation phase: Taking and defending the lead in negotiation talks before finally reaching an agreement (documented by meaningful meeting minutes) • Closing and follow-up phase: Closing or cancelling the deal in an intelligent manner. Monitoring compliance with agreements and response strategies in the event of breaches of agreements (documented by contract and letter/email exchange).
Literature	**Technology and innovation management:** • Tidd, J.; Bessant, J. (2013): *Managing Innovation: Integrating Technological, Market and Organisational Change*, Wiley • Vahs, D.; Brem, A. (2015): *Innovation Management – From Idea to Successful Marketing*, 5th edition, Schäffer-Poeschel Verlag. • Spath, D. et al. (2011): *Technology Management. Fundamentals, Concepts, Methods,* Fraunhofer Verlag. **B-to-B Negotiation:**

	(1) Downloads: Lecture slides and supplementary materials (2) The following recommendations: • Fisher, R., Ury, W. L., & Patton, B. (1991). *Getting to Yes: Negotiating Agreement Without Giving In*. New York, NY: Penguin. • Lewicki, R. J., Saunders, D. M., & Barry, B. (2015). *Essentials of Negotiation* (6th ed.). New York, NY: McGraw-Hill. • Raiffa, H., Richardson, J., & Metcalfe, D. (2002). *Negotiation Analysis: The Science and Art of Collaborative Decision Making.* Cambridge, MA: Belknap. • Thompson, L. L. (2009). *The Mind and Heart of the Negotiator* (4th ed.). Upper Saddle River, NJ: Pearson
Workload	Workload: 6 ECTS x 30 hours = 180 hours Attendance time: 4 hours per week x 15 weeks = 60 hours
Media	Lecture slides, exercise materials, practical exercises in small groups, group discussions and the development of case studies

9. Processes & Data

"Processes & Data"	
Reference number	MWI10070
Semester	2nd semester
Level	Professional academic level
Credits	6
SWS	4
Related courses	MWI10071 Process Analytics MWI10072 Data Management & Analytics
Participation requirements according to SPO	Admission to the Master's programme
Recommended prerequisites	Basic knowledge of descriptive statistics
Examination type(s), examination duration (only for PLK/PLM)	PLK/PLP/PLH/PLR (60 minutes)
Language of instruction	German
Module coordinator	Prof. Dr. Viola Galler
Lecturers	Process Analytics: Prof. Dr. Rebecca Bulander Data Management & Analytics: Prof. Dr. Viola Galler
Curriculum assignment	MIM – Compulsory subject, 2nd semester
Teaching methods used in the module's courses	Lectures and seminars
Objectives	**Process Analytics:** Students learn - the basics of business process management, - how to collect and analyse data from various sources in order to improve business processes, - how to analyse processes using process mining. **Data Management & Analytics:** Students - are familiar with the basics of data management, data structures and the data analysis process - can perform data analysis (using selected methods based on case studies) and interpret the results - are familiar with methods for validating/verifying analysis methods and can apply them
Interdisciplinary qualification objectives	The module promotes abstract and networked thinking.
Contents	**Process analytics:** The course deals with the methods and techniques of process analysis, process management and process mining, and shows how these can be used to improve business processes. **Data Management & Analytics:** Fundamentals of data management, introduction to data structures and the data analysis process, introduction to an analysis tool (e.g. R, Python, Knime, Excel, etc.), selected data analysis methods using case studies, introduction to communicating results (data storytelling)
Literature	**Process Analytics:** • Van der Aalst, W. (2016): *Process Mining: Data Science in Action*. 2nd Edition. Springer: Munich, among others.

	• Reinkemeyer, L. (2020): *Process mining in action: principles, use cases and outlook*. Cham: Springer **Data Management & Analytics:** • v.d. Hude, M. (2020): *Predictive Analytics and Data Mining*, Springer Vieweg, Wiesbaden. • Ghavami, P. (): *Big Data Analytics Methods,* 2nd Edition. De Gruyter, Boston/Berlin. • Further literature will be announced in due course.
Workload	Workload: 6 ECTS x 30 hours = 180 hours Attendance time: 4 hours per week x 15 weeks = 60 hours
Media formats	Transparencies, flipchart, projector, interactive whiteboard, university e-learning platform (Moodle), PC pool

10. Capstone

"Capstone Seminar"	
Reference number	MWI10027
Semester	3rd semester
Level	Professional academic level
Credits	6
SWS	4
Related courses	MWI10028 Capstone Seminar COL6996 Specialised Scientific Colloquium
Participation requirements according to SPO	Admission to the Master's programme
Recommended prerequisites	In-depth knowledge through successful completion of lectures from all areas of the MEM curriculum.
Examination type(s), examination duration (only for PLK/PLM)	Capstone seminar: PLH/PLR/PLP Specialist colloquium: UPL
Language of instruction	German or English
Module coordinator	Prof. Dr. Ansgar Kühn
Lecturers	Capstone Seminar: Alternating lecturers from the field of industrial engineering Specialist colloquium: All full-time professors are eligible to serve as examiners.
Assignment to the curriculum	MIM, MEM – Compulsory subject, 3rd semester
Teaching methods used in the module's courses	Project work, seminar, case study seminar, individual work, preferably in collaboration with companies
Objectives	**Capstone seminar:** The MEM curriculum aims to provide students with a consecutive and generalist education, combined with their individual areas of interest and development goals. The latter are achieved through the selection of compulsory elective subjects and, in some cases, courses at partner universities abroad. At the end of their studies, all students should apply and deepen the breadth of their acquired knowledge and skills in the capstone seminar and identify interdependencies between the individual subject areas. **Specialist colloquium:** Within the framework of individual achievements, students should set individual, subject-specific priorities and address identified weaknesses. Particular attention is paid to aspects of individual career planning. The ability for critical self-reflection is encouraged.
Interdisciplinary qualification goals	The module contributes to teamwork and (self-)reflection skills.
Contents	**Capstone Seminar:** The seminar is designed by the supervising professors depending on the number of participants and the topics to be covered. Project work and/or case study seminars are used for this purpose. The topics, dates and proportions of attendance phases are determined at an early stage. **Specialist colloquium:** The content depends on the individual student. In particular, aspects of academic or professional qualifications, e.g. additional

	qualifications beyond the curriculum, should be taken into ac-count here. Key topics are determined in consultation with the supervising professors.
Literature	Will be announced in good time.
Workload	Workload: 6 ECTS x 30 hours = 180 hours Of which attendance time: 4 hours per week x 15 weeks = 60 hours
Media formats	Seminar / project or interactive teaching discussion

11. Master's thesis

"Master's thesis"	
Reference number	THE6880
Semester	3rd semester
Level	Expert level
Credits	24
SWS	0
Related courses	None
Participation requirements according to SPO	The Master's thesis can be assigned at the earliest in the 2nd semester.
Recommended prerequisites	Solid technical and scientific knowledge from the Master's programme.
Type of examination(s), duration of examination (only for PLK/PLM)	PLT
Language of instruction	German or English
Module coordinator	Responsible professor
Lecturers	All professors in the department.
Assignment to the curriculum	MEM, MIM – compulsory subject, 3rd semester
Teaching methods used in the module's courses	Thesis
Objectives	The Master's thesis should demonstrate that students are able to independently work on a problem in industrial engineering within a specified time frame using scientific methods and solve it precisely and efficiently. To this end, they are able to research available scientific findings and develop their own theoretical concepts and models. They have mastered the necessary methods and procedures. They select suitable methods and apply them correctly, adapt them, develop them further and test their viability when dealing with complex problems.
Interdisciplinary Qualification goals	Students are able to present complex topics in a differentiated manner from different perspectives and prepare them in accordance with academic standards. Through their thesis, they demonstrate their sound analytical thinking skills and critical judgement using scientific methods. They are able to plan and carry out an academic thesis project over a longer period of time, thereby demonstrating their perseverance. Students also demonstrate that they can clearly formulate their findings and present them in writing in an academically appropriate manner. Students are able to critically compare their own results with other approaches, evaluate their own results and thus make a significant contribution to the field of science or provide a solution with high practical relevance.
Contents	A topic that is usually related to the faculty's main areas of research is assigned to students for study or, alternatively, proposed by the students themselves. It must be related to the field of economics and/or engineering in terms of subject matter and cover subject-specific or interdisciplinary current issues and topics.

	Students independently research the available scientific findings, carry out their own analyses and formulate theses. They also conduct their own empirical or theoretical research work in order to achieve the objectives set for the Master's thesis. To this end, they develop their own theories and models, which they verify or refute according to scientific criteria.
Literature	Topic-specific literature, to be selected by the students.
Workload	Processing time 6 months, 24 ECTS x 30 hours = 720 hours of processing, including documentation.
Media formats	Printed and electronic copies.

II. Course structure in the English track

1. Leadership

"Leadership"	
Reference number	MWI10029
Semester	1st semester
Level	Professional academic level
Credits	6
SWS	4
Related courses	MWI10030 Leading Virtual Teams MWI10031 Applied Leadership
Participation requirements according to SPO	Admission to the Master's programme
Recommended requirements	English B2
Examination type(s), examination duration (only for PLK/PLM)	PLH/PLK/PLP/PLR (60 minutes)
Language of instruction	English
Module coordinator	Prof. Dr. Jasmin Mahadevan
Lecturers	Leading Virtual Teams: Prof. Dr. Jasmin Mahadevan Applied Leadership: Prof. Dr. Cathrin Eireiner
Curriculum assignment	MIM – Compulsory subject 1st semester
Teaching methods used in the module's courses	Lecture, seminar-style teaching, workshop, coaching, real-world project
Objectives	**Applied leadership:** Students • are familiar with the tasks and various roles of a manager • are familiar with various leadership concepts and their context dependency • have explored the mindset required for a leadership role • are aware of the relevance of personality and attitude in leadership tasks **Leading Virtual Teams:** Students • are aware of the importance of virtual teamwork as an increasingly relevant form of organisation and work and know when and how it should (not) be used • are familiar with the requirements for virtual team collaboration and know methods and ways to meet these requirements • can analyse and evaluate virtual team collaboration in a structured manner and derive situation- and case-specific criteria for 'good leadership' • are aware of the importance of self-leadership and leadership identity as well as team-based and decentralised leadership for successful virtual team collaboration
Interdisciplinary Qualification goals	The module contributes significantly to personal development, in particular by strengthening the ability to reflect (on oneself), interact with other people/in a team and other social skills. This enables responsible leadership in the context of virtual, hybrid and non-virtual organisations.
Contents	**Applied leadership:** • Leadership tools

	• Leadership concepts • Leadership mandate and roles • Understanding leadership • Leadership mindset and leadership skills **Leading virtual teams:** • Fundamentals and forms of virtual team collaboration • Opportunities and risks of virtual teams • Special requirements for leadership in virtual teams • Special features of interdisciplinary, diverse, intercultural, flexible and/or global virtual teams • Key topics for successful leadership in virtual teams, e.g. cultural intelligence and intercultural competence; leadership identity and leadership styles; trust, learning and change; interaction and technology; diversity and dispersion, new forms of work (work-from-home, work-from-anywhere, flexible work arrangements, etc.)
Literature	**Applied leadership:** • Alznauer, M. (2016) Leading Naturally: The Evolutionary Source Code of Leadership. Springer. Frankfurt am Main. • McDonald, S.M. (2016) Leadership Attitude: How Mindset and Action can Change Your World. LeadershipHQ **Leading Virtual Teams:** • Mahadevan, J. (2024) Virtual Team Collaboration. Springer: Frankfurt am Main. • Further reading will be announced in the seminar
Workload	Workload: 6 ECTS x 30 hours = 180 hours Attendance time: 4 hours per week x 15 weeks = 60 hours.
Media	Slides, flipchart, projector, lectures in the form of presentations, case studies, active board, behavioural simulations, reflection

2. Networked Systems & Artificial Intelligence

"Networked Systems & Artificial Intelligence"	
Reference number	MWI10032
Semester	1st semester
Level	Professional academic level
Credits	6
SWS	4
Related courses	MWI10033 Applications of Artificial Intelligence MWI10034 Networked Systems – Fundamentals & Applications
Participation requirements according to SPO	Admission to the Master's programme
Recommended prerequisites	English B2
Examination type(s), examination duration (only for PLK/PLM)	PLH/PLK/PLP/PLR (60 minutes)
Language of instruction	English
Module coordinator	Prof. Dr Bernhard Kölmel
Lecturers	Applications of Artificial Intelligence: Prof. Dr. Raphael Volz Networked Systems – Fundamentals & Applications: Prof. Dr Bernhard Kölmel
Curriculum assignment	MIM – Compulsory subject, 1st semester
Teaching methods used in the module's courses	Lecture, seminar-style teaching
Objectives	**Applications of artificial intelligence:** • The aim of this course is to give students an understanding of the various applications of artificial intelligence (AI). Fundamental concepts and techniques of AI are presented and explained using concrete application examples. • Students will learn how AI algorithms and models can be used in various areas such as image recognition, language processing, data analysis and decision-making. They will become familiar with the relevant AI methods and tools for developing, implementing and evaluating these applications. • Another goal is to make students aware of the ethical and social aspects of AI applications. They should understand the impact AI systems can have on privacy, the labour market, social justice and other areas, and how these aspects should be taken into account when developing and implementing AI applications. **Networked Systems – Fundamentals & Applications:** • The main objective of this course is to provide students with a basic understanding of networked systems. It covers the fundamental concepts, technologies and protocols for communication and interaction between networked devices and systems. • Students will develop an understanding of how networked systems are used in various application areas such as the Internet of Things (IoT), smart cities, Indus-

	try 4.0 and smart homes. They will learn how these systems are designed, implemented and operated, including aspects such as network topologies, protocols, security and data management. • Another goal is to teach students the importance and challenges of interoperability and scalability in networked systems. They will learn how different components and devices can communicate and work together, as well as understand the possibilities and limitations of these systems in order to develop effective and reliable applications.
Interdisciplinary Qualification goals	• Systemic thinking: One interdisciplinary qualification objective is to develop the ability to think systemically. This involves understanding complex relationships and interactions between different disciplines, subject areas and actors. Systemic thinking enables complex problems to be analysed holistically and comprehensive solutions to be developed that go beyond the boundaries of individual disciplines. • Innovation and creativity: Another goal is to promote innovation and creativity through the exchange and integration of knowledge from different disciplines. By combining different perspectives and ideas, innovative approaches and solutions can be developed. Interdisciplinary collaboration makes it possible to break through conventional patterns of thinking and find new ways to tackle complex problems. • Ethics and sustainability: An important qualification goal is to raise awareness of ethical and sustainability issues. Interdisciplinary collaboration requires consideration of social, environmental and economic impacts. Students should recognise the ethical implications of their actions and be able to develop sustainable solutions that have long-term positive effects. • Science communication: Another goal is to develop the ability to communicate complex scientific content effectively across disciplinary boundaries. Students should be able to present their knowledge and research findings in a clear and understandable way, both to experts and to a wider audience. Clear and convincing communication can help to successfully communicate interdisciplinary projects and facilitate collaboration with experts from other disciplines.
Contents	**Applications of Artificial Intelligence:** 6. Introduction to Artificial Intelligence: The course begins with a basic introduction to the field of artificial intelligence. Students learn about the concepts, goals and applications of AI. 7. AI algorithms and models: Various AI algorithms and models are presented, including machine learning, neural networks, decision trees, genetic algorithms and more. Students learn how these algorithms work and what applications they have. 8. Applications of AI: The course covers specific examples of artificial intelligence applications. These include areas

	such as image recognition, speech processing, automated decision-making, robotics, autonomous vehicles and many others. 9. Data analysis and pre-processing: Since AI is heavily dependent on data, students learn how to analyse, pre-process and prepare data for AI applications. Topics such as data cleaning, feature extraction, dimension reduction and data visualisation are covered. 10. Ethics and responsibility: The course also covers the ethical and social aspects of artificial intelligence applications. Students learn to identify and discuss ethical issues related to data protection, discrimination, trust and transparency. It also discusses how AI systems can be developed and used responsibly. **Networked Systems – Fundamentals & Applications:** 6. Introduction to Networked Systems: The course begins with an introduction to the fundamentals of networked systems. Students learn about the concepts, principles and technologies behind the networking of devices and systems. 7. Network architectures and protocols: Various network architectures such as client-server, peer-to-peer and cloud computing are covered. In addition, the most important network protocols such as TCP/IP, HTTP, MQTT and others are introduced and their applications explained. 8. Internet of Things (IoT): One focus is on the Internet of Things, an important area of application for networked systems. Students learn the basics of IoT, including sensor technologies, connectivity, data management and areas of application such as smart homes, wearables and Industry 4.0. 9. Security and data protection: In view of increasing networking and data exchange, security and data protection aspects are also covered. Students learn the basic principles of network security, encryption techniques, access controls and data protection regulations to protect networked systems from threats. 10. Applications and case studies: The course also includes the examination of specific applications and case studies of networked systems. This may include smart cities, intelligent transport systems, health technologies or other areas. Students gain insights into real-world applications and discuss the challenges, opportunities and impacts of networked systems in various areas.
Literature	**Applications of Artificial Intelligence:** • Russell, S., & Norvig, P. (2016). *Artificial Intelligence: A Modern Approach* (3rd ed.). Pearson. • Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning.* MIT Press. • Murphy, K. P. (2012). *Machine Learning: A Probabilistic Perspective*. MIT Press. • Bishop, C. M. (2006). *Pattern Recognition and Machine Learning.* Springer. • **Networked Systems – Fundamentals & Applications:**

	• Ray, P. P. (2021). *Internet of Things: A Hands-On Approach* (2nd ed.). Springer. • Li, S., Da Xu, L., & Zhao, S. (2020). *Internet of Things for Industry 4.0: Design, Technologies, and Applications.* CRC Press. • Yan, Z., Zhang, P., & Vasilakos, A. V. (Eds.). (2020). *Internet of Things: Principles and Paradigms*. Wiley. • Misra, S., Agarwal, P. K., & Mahadevappa, V. G. (Eds.). (2020). *Handbook of Research on IoT and Big Data Technologies for Enterprises.* IGI Global.
Workload	Workload: 6 ECTS x 30 hours = 180 hours Attendance time: 4 hours per week x 15 weeks = 60 hours 120 hours of preparation/follow-up work for lectures and exam preparation.
Media	Lectures with discussion, case studies with seminar exercises in small groups

3. Research Methods & Innovation

"Research Methods & Innovation"	
Reference number	MWI10007
Semester	1st semester
Level	Professional academic level
Credits	6
SWS	4
Related courses	MWI10008 Research Methods MWI10009 Product Strategy/Product Development
Participation requirements according to SPO	Admission to the Master's programme
Recommended requirements	English B2
Examination type(s), examination duration (only for PLK/PLM)	PLH/PLR/PLK (60 minutes)
Language of instruction	German or English
Module coordinator	Prof. Dr Ludwig Martin
Lecturers	Research methods: Prof. Dr Ludwig Martin Product strategy/product development: Prof. Dr. Henning Hinderer/Prof. Dr. Rainer Wunderlich
Curriculum assignment	MIM, MEM – Compulsory subject 1st semester
Teaching methods used in the module's courses	Seminar-based teaching and exercises, block course with follow-up sessions, project
Objectives	**Research methods:** Students are familiar with the variety of research approaches and can classify them in terms of scientific theory. Based on specialist knowledge of common qualitative and quantitative methods, students can design (smaller) research projects and draw up project plans. Students can identify related ethical issues and formulate possible solutions. In addition, they can critically evaluate and classify their own results as well as those of others, also with regard to the methodology and methods used. Students are aware of the interdisciplinary nature of the programme in terms of research approaches and know how to deal with this, including in terms of the admissibility of different perspectives and creative problem solving. By combining this with specialist knowledge from the elective modules of the programme, they can also classify their own contributions in technical terms. **Product strategy/product development:** After a methodological introduction to the areas of strategic product planning, creativity methods and methods of market-oriented product development, students are able to systematically develop a new product from the idea to marketing. Important components are the creative generation of ideas and the derivation of the contents of a suitable business model and a market launch strategy. In small groups, students develop their own product idea, which is to be implemented as a prototype for a planned market launch . There is the option of supporting the product ideas with a business plan in further modules, e.g. IDP or Master's thesis.
Interdisciplinary Qualification goals	The module contributes to the further development of students' understanding of methods and the development and marketing

	of products. The connection between the application and understanding of methods (research and product development) and the corresponding results is taught. This also applies to the evaluation of areas of application of methods and their limitations.
Contents	**Research methods:** The prevailing paradigms of knowledge acquisition are explained and distinguished from one another. Various approaches and related methodologies are explained through a research problem-oriented introduction to the topic. Engineering and social science (including business research) approaches and related methods are introduced, explored in depth and discussed using exercises and case studies. With reference to empirical research, questions regarding the validity and reliability of various methods and approaches are discussed. Issues of scientific ethics are explored and solutions are developed using examples. Basic forms of good scientific practice (e.g. declarations of consent in surveys, avoidance of plagiarism, dealing with generative AI) are discussed. The procedure for classifying one's own contribution within existing knowledge (state of the art/state of science) is explained and practised. Source work and the critical processing of what has been read into one's own texts is demonstrated and consolidated through exercises. **Product strategy/product development:** Methods of strategic product planning and market-oriented product development are explained, discussed and used experimentally with the aim of preparing a strategic and market-oriented development of a product based on one's own idea. Strategic product planning: • Approaches to agile product development (scenario building, design thinking approaches, BMC) • Practical application of strategic methods in the context of product design Approaches to idea generation: • Analysis of trends and innovative technologies as approaches to idea generation • Design thinking and other creativity methods Methods of market-oriented product development: • Product development methods • Market research and testing methods • Market launch strategy with communication plan
Literature	**Research methods:** • Leedy, P. D., Ormrod, J. E. (2016): *Practical Research: Planning and Design.* 11th Edition, Pearson. • Bryman, A., Bell, E. (2015): *Business Research Methods*. 4th Edition, Oxford University Press: Oxford. • Kornwachs, K. (2010): *Technological Knowledge – Origin, Methods, Structures.* Acatech/Springer: Berlin. (PDF available online) Lindenlauf, F. (2022): *Scientific Work in Engineering and Natural Sciences*. Springer Spektrum: Berlin. • Various texts available on e-learning **Product strategy/product development:** • Porter, M. E. (2013): *Competitive Strategies*. 12th edition, Campus: Frankfurt/Main.

	• Lewrick, M., Link, P., Leifer, L. (2018): *The Design Thinking Playbook.* 2nd edition, Vahlen: Munich. • Osterwalder, A., Pigneur, Y. (2011): *Business Model Generation*. Campus: Frankfurt/Main. • Gerstbach, I. (2016): *Design Thinking in Business. A workbook for introducing design thinking*. Gabal: Offenbach. • Bland, D. J., Osterwalder, A., Smith, A., & Papadakos, T. (2020). *Testing business ideas*: Wiley: Hoboken. • Ulrich, K. T., Eppinger S. D. (2012): *Product design and development.* 5th Edition, McGraw-Hill: New York.
Workload	Workload: 6 ECTS x 30 hours = 180 hours Attendance time: 4 hours per week x 15 weeks = 60 hours
Media formats	PowerPoint, handouts, interactive group tasks, individual tasks, interactive teaching discussions, research work (including library), discussion of models and drafts.

4.

"Interdisciplinary Innovation/Research Project"	
Reference number	MWI10010
Semester	1st/2nd semester
Level	Vocational academic level
Credits	9
SWS	6
Related courses	MWI10011 Innovation/Research Project Design MWI10012 Innovation/Research Project Implementation
Participation requirements according to SPO	Admission to the Master's programme
Recommended prerequisites	Parallel participation in the courses MWI10008 Research Methods and MWI10009 Product Strategy/Product Development
Examination type(s), examination duration (only for PLK/PLM)	PLP in each case
Language of instruction	German or English
Module coordinator	Prof. Dr. Ansgar Kühn
Lecturers	Innovation/research project design: all lecturers in the Industrial Engineering department Innovation/research project implementation: all lecturers in the Industrial Engineering department
Curriculum assignment	MIM, MEM – compulsory subject 1st/2nd semester
Teaching methods for the module's courses	Project in small groups (4 people) with intensive supervision by a teacher across both courses
Objectives	Students are familiar with the diversity of research approaches and can classify them in terms of scientific theory and apply them in specific projects. They are also familiar with a variety of innovation methods. Based on specialist knowledge of common qualitative and quantitative methods, students will be able to design (smaller) research/innovation projects and implement them in prototype form to clarify relevant issues. Students will be able to identify any associated ethical issues and develop solutions. In addition, they can critically evaluate and classify their own results as well as those of others, including with regard to the methodology and methods used. Students are aware of the interdisciplinary nature of the programme in terms of innovation and research approaches and know how to deal with this, including in terms of the admissibility of different perspectives and creative solution finding, and feedback from stakeholders in a target market. By combining this with specialist knowledge from the compulsory and elective modules of the programme, they can also classify their own contributions in technical terms. Students can develop, adequately document and present solutions in an innovation project/research project (also in collaboration with external companies). This also includes the possibility of publishing the work or its results.
Interdisciplinary qualification goals	The module contributes to management skills, teamwork and project management skills. It strengthens the ability for critical reflection and creative problem-solving.

Contents	Potential research and innovation projects are presented by various lecturers at the beginning of the module. The research/innovation projects can be of different natures and involve a wide variety of problems. • The lecturers teaching the elective modules specify the topics of the research/innovation project, which can also be carried out in collaboration with external companies. • The problems are always solved on a scientific basis and the project documentation is written as a scientific paper or as product documentation in a suitable form (drawing, parts list, product description, manual, etc.). • Ideally, the project work concludes with a scientific paper worthy of publication or a concrete and detailed product/business idea, including a functional prototype if possible. The lecturers are available to the students as mentors. **Innovation/research project concept:** The prevailing paradigms of knowledge acquisition are explained and distinguished from one another. Various approaches and related methodologies are explained through a research problem-oriented introduction to the topic. Engineering and social science (including business research) approaches and related methods are introduced and discussed in depth using exercises and case studies. With reference to innovation and application-oriented development, all aspects of product development are discussed – this includes methods of market research and target group analysis, documentation and validation of requirements, and an iterative approach to the project. In projects involving empirical research, questions regarding the validity and reliability of various methods and approaches are also discussed. **Innovation/research project implementation:** Building on the knowledge gained in the Innovation/Research Project Design course, students work on a research/innovation project and produce a coherent documentation of their work. In innovation projects, market and user feedback should be determined using functional prototypes wherever possible and taken into account in further development.
Literature	**Innovation/Research Project Design:** • Leedy, P. D., Ormrod, J. E. (2016): *Practical Research: Planning and Design.* 11th Edition, Pearson. • Bryman, A., Bell, E. (2015): *Business Research Methods*. 4th Edition, Oxford University Press: Oxford. • Kornwachs, K. (2010): *Technological Knowledge – Origin, Methods, Structures.* Acatech/Springer: Berlin. (PDF available online) • Großklaus, Rainer H. G. (2014): *From Product Idea to Market Success: Planning, Introducing and Successfully Managing Innovations.* - 2nd edition 2014. - Wiesbaden: Gabler Verlag, 2014. • Further reading as required **Innovation/research project implementation:** • • Bland, D. J., Osterwalder, A., Smith, A., & Papadakos, T. (2020). *Testing business ideas*: Wiley: Hoboken. • Engeln, Werner (2006): *Methods of product development*. Munich: Oldenbourg-Industrieverlag.

	• Schwarz, Erich J.; Dummer, Rita; Krajger, Ines (2007): *From Business Idea to Market Success*. Vienna: Linde Verlag • Subject-specific literature depending on the respective project work.
Workload	Workload: 9 ECTS x 30 hours = 270 hours. Innovation/research project concept: 3 ECTS Innovation/research project implementation: 6 ECTS Attendance time: 6 hours per week x 15 weeks = 90 hours or attendance time in consultation with supervisor / depending on project
Media formats	Depending on the respective project work/supervisor: PowerPoint, handouts, interactive group tasks, physical or IT-based prototypes, interactive teaching discussions, research work (library).

5. Elective subjects "Focus"

Subjects worth 9 ECTS credits must be selected from the Master's programmes offered by the WI department and/or other departments/faculties of the university in consultation with the programme director and the respective lecturer. Subjects must be reported to the Examination Office either by list or, if necessary, individually by form.

Individual courses can be combined individually, or entire elective modules can be taken. There is no guarantee that there will be no overlap. A list of the elective subjects or modules available in the programme can be viewed at the programme director's office.

"Elective subjects "Focus"" / "Electives "Focus""	
Reference number	MWI10023
Semester	1st/2nd semester
Level	Vocational academic level
Credits	9
SWS	6
Related courses	MWI10024 Focus A MWI10025 Focus B MWI10026 Focus C
Participation requirements according to SPO	Admission to the Master's programme
Recommended requirements	Technical and organisational questions, especially for Master's courses that are not run by the WI department, must be clarified with the lecturer in advance.
Examination type(s), examination duration (only for PLK/PLM)	PLH/PLK/PLP/PLR (exam duration according to elective list)
Language of instruction	German or English
Module coordinator	Prof. Dr. Ansgar Kühn
Lecturers	The respective lecturers of the selected Master's courses from the elective list.
Assignment to the curriculum	MIM, MEM – compulsory elective subject 1st/2nd semester
Teaching methods used in the module courses	Depending on the selected courses, seminar-style teaching, lectures or projects.
Objectives	Students acquire additional, in-depth knowledge within the framework of specialisation subjects of their own choice. The wide range of Master's courses offered by Pforzheim University gives students the opportunity to set their own individual priorities.
Interdisciplinary Qualification goals	Depending on the selected courses
Contents	These depend on the selected courses from the elective list. Courses can be selected from the Master's programmes offered by all three faculties of the university in consultation with the programme director and the respective lecturer. The subjects that can be selected are listed in a list (selection list). Courses can be combined individually or taken as entire elective modules. There is no entitlement to admission or freedom from overlap.
Literature	This depends on the selected courses from the elective list.
Workload	Workload: 9 ECTS x 30 hours = 270 hours.

	Attendance time: 6 hours per week x 15 weeks = 90 hours of attendance time
Media formats	Depending on the selected courses.

6. Major Industrial Management I

"Major Industrial Management I"	
Reference number	MWI10045
Semester	1st/2nd semester
Level	Vocational academic level
Credits	6
SWS	4
Related courses	MWI10046 Seminar Industrial Management A MWI10047 Seminar Industrial Management B
Participation requirements according to SPO	Admission to the Master's programme
Recommended requirements	English B2
Examination type(s), examination duration (only for PLK/PLM)	PLH/PLK/PLP/PLR respectively (60 minutes)
Language of instruction	Seminar Industrial Management A: English Seminar Industrial Management B: German or English
Module coordinator	Prof. Dr. Ansgar Kühn
Lecturers	Seminar Industrial Management A: TBD Seminar Industrial Management B: TBD
Curriculum assignment	MIM – Compulsory subject 1st/2nd semester
Teaching methods used in the module's courses	Seminar/lecture/workshop
Objectives	Students acquire in-depth knowledge and skills to enable effective management in industrial organisations. To this end, the module teaches both theoretical principles and practical application to enable students to take on various management tasks in a complex, technically oriented environment. In particular, students learn about the special requirements of selected complex and interdisciplinary issues and are able to develop convincing solutions. Where possible, the module is designed to take into account the students' initial qualifications, thus enabling targeted knowledge transfer.
Interdisciplinary Qualification goals	The module strengthens critical reflection and problem-solving skills as well as interdisciplinary competencies.
Contents	The field of industrial management covers a wide range of topics. In addition to the topics covered in other modules, additional topics can be specifically included or explored in greater depth in the Industrial Management I major. This includes, among other things: • Strategy and organisation: aspects of structural and procedural organisation, industry, competition and market analysis, strategy development and strategic planning • Operations management: principles and tools for the effective control of industrial operations processes. This includes process improvement, supply chain management, quality control and productivity improvement methods. • HR management: Management of HR in an industrial environment in all aspects along the HR lifecycle

	• Financial management: Special emphasis on decision-making and resource allocation, analysis, budgeting, controlling, investment decisions, risk assessment. • Sustainability & Resilience: Integration of sustainable and environmentally friendly working methods and processes in manufacturing companies. CSR, sustainable and resilient supply chains, energy management, circular economy, green manufacturing
Literature	To be announced by the lecturer.
Workload	Workload: 6 ECTS x 30 hours = 180 hours Attendance time: 4 hours per week x 15 weeks = 60 hours
Media formats	PowerPoint, flipchart, practical lecture

7a. Major Engineering

Depending on the proven initial qualification, one of the modules 7a, 7b or 7c must be completed:

- 7a for students without a relevant technical bachelor's degree;
- 7b for students with a technical bachelor's degree;
- 7c for students who can demonstrate both technical and commercial entry qualifications from their bachelor's degree, e.g. by comparison with the WI qualification framework; in this case, subjects worth 6 ECTS must be taken.

The 7a/7b/7c classification is determined after individual review by the programme director as part of a binding study agreement.

"Major Engineering"	
Reference number	MWI10060
Semester	1st semester
Level	Professional academic level
Credits	3
SWS	2
Related courses	MWI10049 Engineering Fundamentals
Participation requirements according to SPO	Admission to the Master's programme
Recommended prerequisites	English B2
Examination type(s), examination duration (only for PLK/PLM)	PLH/PLK/PLP/PLR (60 minutes)
Language of instruction	English
Module coordinator	Prof. Dr. Kai Oßwald
Lecturers	Engineering Fundamentals: Prof. Dr. Kai Oßwald
Curriculum assignment	MIM – Compulsory subject 1st semester
Teaching methods used in the module's courses	Seminar-style lecture with practical exercises
Objectives	• Teaching the fundamentals of technical communication • Practising engineering calculations • Introduction to fundamental engineering subjects
Interdisciplinary Qualification objectives	The module teaches the most essential technical fundamentals for students with little or no prior technical training. This lays the groundwork for the technical subjects in the degree programme.

Contents	**Engineering fundamentals:**
	• Fundamentals (1 unit)
	    o Calculations
	        ▪ Fundamentals
	        ▪ Examples
	        ▪ Fermi problems
	    o Units
	• Technical drawing (2 units)
	    o Descriptive geometry, projections, views
	    o Threads, dimensions
	    o Exercises
	• Technical mechanics (3 units)
	    o Forces and torques (central and general force systems)
	    o Stress and strength
	• Materials science (4 units)
	    o Metals: lattices, crystallites, dislocations, iron-carbon diagram

	- Fundamentals of polymers - Formation and behaviour - Basic manufacturing processes - Electrical engineering (4 units) - Direct current - Resistance, Kirchhoff's laws - Alternating current - Transformers - Three-phase current - Power, energy - Digital technology - Calculating with electrical quantities
Literature	OBERG, Erik. *Machinery's Handbook, Toolbox & Calc Pro 2 Combo*. 2016.
Workload	Workload: 3 ECTS x 30 hours = 90 hours Attendance time: 2 hours per week x 15 weeks = 30 hours
Media	Slide presentations, video, blackboard notes

7b. Major Business

Depending on the proven entry qualification, one of the modules 7a, 7b or 7c must be completed:

- 7a for students without a relevant technical bachelor's degree;
- 7b for students with a technical bachelor's degree;
- 7c for students who can demonstrate both technical and commercial entry qualifications from their bachelor's degree, e.g. by comparison with the WI qualification framework; in this case, subjects worth 6 ECTS must be taken.

The 7a/7b/7c classification is determined after individual review by the programme director as part of a binding study agreement.

"Major Business"	
Reference number	MWI10062
Semester	1st semester
Level	Professional academic level
Credits	3
SWS	2
Related courses	MWI10051 Business Management
Participation requirements according to SPO	Admission to the Master's programme
Recommended prerequisites	English B2
Examination type(s), examination duration (only for PLK/PLM)	PLH/PLK/PLP/PLR (60 minutes)
Language of instruction	English
Module coordinator	Prof. Harald Schnell
Lecturers	Business Management: Prof. Harald Schnell
Curriculum assignment	MIM – Compulsory subject 1st semester
Teaching methods used in the module's courses	Seminar-based teaching including a business simulation with workshop character
Objectives	In the form of a seminar with workshop character, students learn the thinking and behaviour of business people using a business simulation. Students learn how to manage a company commercially, analysing and ensuring effectiveness and efficiency within the company. Students learn how to use numerous commercial tools, such as market and SWOT analysis tools, product costing, cash flow accounting and the basics of accounting.
Interdisciplinary qualification goals	In addition to the commercial expertise that forms the core of teaching in this subject, other goals and requirements that compete with commercial activity are discussed with the students. This promotes ethical awareness in commercial enterprises. Furthermore, students learn to think beyond departments and functional areas in complex companies and to communicate and collaborate with each other in a variety of ways within the company.
Contents	• Introduction to business administration: Setting goals – tapping into markets – ensuring profitability – securing financing – monitoring goals with Bosch key figures • Business planning and budgeting (BP): content, structure, process, participants

	• Market analysis and market orientation of the company: market research and marketing • Capacity and financial planning in the company • Pricing and costing: Fundamentals of PPC (product cost) determination at Bosch • Measuring the achievement of business objectives using Bosch-specific key figures, including EBIT, return on investment (ROI), break-even point, cockpit charts • Monitoring business development using Bosch contribution margin accounting and the balance sheet
Literature	• Wöhe/Döring/Brösel: *Introduction to General Business Administration* – Vahlen-Verlag: Munich / latest edition • Wöhe/Kaiser/Döring: *Workbook for Introduction to General Business Administration* – Vahlen-Verlag: Munich / latest edition
Workload	Workload: 3 ECTS x 30 hours = 180 hours Attendance time: 2 hours per week x 15 weeks = 60 hours
Media formats	Workshop using pinboards, flipcharts and a business simulation manual, plus a set of slides on the basics of business administration

7c. Major Industrial Management II

Depending on the proven entry qualification, one of the modules 7a, 7b or 7c must be completed:
- 7a for students without a relevant technical bachelor's degree;
- 7b for students with a technical bachelor's degree;
- 7c for students who can demonstrate both technical and commercial entry qualifications from their bachelor's degree, e.g. by comparison with the WI qualification framework; in this case, subjects worth 6 ECTS must be taken.

The 7a/7b/7c classification is determined after individual review by the programme director as part of a binding study agreement.

"Major Industrial Management II"	
Reference number	MWI10064
Semester	1st semester
Level	Professional academic level
Credits	3
SWS	2
Related courses	MWI10053 Focus D
Participation requirements according to SPO	Admission to the Master's programme
Recommended prerequisites	Technical and organisational questions, especially for Master's courses that are not run by the WI department, must be clarified with the lecturer in advance.
Examination type(s), examination duration (only for PLK/PLM)	PLH/PLK/PLP/PLR (exam duration according to elective list)
Language of instruction	German or English
Module coordinator	Prof. Dr. Ansgar Kühn
Lecturers	The respective lecturers of the selected Master's courses from the elective list.
Assignment to the curriculum	MIM – Elective subject 1st semester
Teaching methods used in the module's courses	Depending on the selected courses, seminar-style teaching, lectures or projects.
Objectives	Students acquire additional, in-depth knowledge within the framework of specialisation subjects of their own choosing. The wide range of Master's courses offered by Pforzheim University gives students the opportunity to set their own individual priorities.
Interdisciplinary Qualification goals	Depending on the selected courses
Contents	These depend on the selected courses from the elective list. Courses can be selected from the Master's programmes offered by all three faculties of the university in consultation with the programme director and the respective lecturer. The subjects that can be selected are listed in a list (selection list). Courses can be combined individually or taken as entire elective modules. There is no entitlement to admission or freedom from overlap.
Literature	This depends on the selected courses from the elective list.
Workload	Workload: 3 ECTS x 30 hours = 90 hours Attendance time: 2 hours per week x 15 weeks = 30 hours attendance time

Media	Depending on the selected courses.

8. Management of new technologies

"Management of Emerging Technologies"	
Reference number	MWI10016
Semester	2nd semester
Level	Professional academic level
Credits	6
SWS	4
Related courses	MWI10017 Technical Concepts MWI10018 Organisational Concepts
Participation requirements according to SPO	Admission to the Master's programme
Recommended requirements	English B2
Examination type(s), examination duration (only for PLK/PLM)	PLK/PLP (60 minutes)
Language of instruction	English
Module coordinator	Prof. Dr Bernhard Kölmel
Lecturers	Technical concepts: Dr Michael Krutwig (LB) Organisational concepts: Prof. Dr Bernhard Kölmel
Curriculum assignment	MIM English Trackm, MEM – compulsory subject 2nd semester (MEM – compulsory subject 2nd semester)
Teaching methods used in the module	Seminar-style teaching and exercises, block course with follow-up sessions. The course is designed to be interactive. Current examples from practice illustrate the content. Project (exemplary implementation of a technical prototype).
Objectives	Students • understand the significance of new technologies for the future of the economy, • be able to apply the basic concepts of managing emerging technologies, • can design and implement a technical prototype.
Interdisciplinary Qualification goals	• Technological competence: Students should develop technological knowledge and understanding in order to recognise and evaluate new technologies and successfully introduce them into companies. • Strategic thinking: Emphasis is placed on strategic thinking in order to recognise the potential of new technologies and integrate them into a holistic corporate strategy. • Interdisciplinary collaboration: The lecture promotes the ability to collaborate across different disciplines in order to master the complexity of new technologies and develop innovative solutions.
Contents	Global competition for the development of new technologies is becoming increasingly fierce. At the same time, product life cycles are becoming shorter. The result is an "innovation race" in which it is important to recognise and seize technological options at an early stage. This is the only way to capture market opportunities and exploit important competitive advantages. This raises the question for companies of how to recognise the potential of new technologies in good time and how to use them as efficiently and effectively as possible. These are key questions in the potential of new technologies in a timely manner and how to

	use them as efficiently and effectively as possible . These are key questions in the management of new technologies. The event provides an overview of the international development of key new technologies, presents important methods of technology management and discusses the technical, economic and social significance of emerging technologies. Basic concepts of technology management are introduced and the management of new technologies is explored in depth using case studies. Looking at emerging digital business models, certain similarities in their architectures are apparent in many cases. Cloud services are often used to provide the basis for complete networking. Cloud services provide certain services that generate added value for the end user. The use of IoT (Internet of Things) generates large amounts of data and data streams due to the many sensors and data streaming involved. However, in the IoT, cloud services are not limited to storing "streamed" mass data from sensors and smart objects, but generate added value for the end user by processing and providing further information, e.g. in the context of predictive analytics and actuator control. Prototypes are being implemented as part of a project.
Literature	• Schilling, M. A. (2012): *Strategic Management of Technological Innovation.* 4th edition, McGraw-Hill Education. • Schuh, G., Klappert, S. (2011): *Technology Management – Handbook of Production and Management 2.* 2nd edition, Springer: Heidelberg. • Wördenweber, W. (2008): *Technology and Innovation Management.* 3rd edition, Springer: Heidelberg. • Wilder, B. (2012): *Cloud Architecture Patterns*. O'Reilly and Associates. • Provost, F., Fawcett, T. (2013): *Data Science for Business: What you need to know about data mining and data-analytic thinking.* O'Reilly and Associates.
Workload	Workload: 6 ECTS x 30 hours = 180 hours. Attendance time: 4 hours per week x 15 weeks = 60 hours Of which 30 hours are devoted to teaching concepts and methods and 30 hours to using the methods and presenting emerging concepts. 120 hours of project development and elaboration as well as preparation of the final presentation
Media formats	Slides, flipchart, videos, active board, university e-learning platform.

9. Cross-border cooperation

"Cross Border Cooperation"	
Reference number	MWI10019
Semester	2nd semester
Level	Professional academic level
Credits	6
SWS	4
Related courses	None
Participation requirements according to SPO	Admission to the Master's programme
Recommended requirements	English B2
Examination type(s), examination duration (only for PLK/PLM)	PLP
Language of instruction	English
Module coordinator	Prof. Dr. Ansgar Kühn
Lecturers	Prof. Dr. Ansgar Kühn
Curriculum assignment	MIM English Track, MEM – compulsory subject, 2nd semester
Teaching methods used in the module's courses	Seminar-based teaching/project work in collaboration with a company, combined with a study trip abroad
Objectives	Globalisation has significantly changed both the market environment and the corporate structures of companies. Companies anticipate further intensification of global competition and must face the formidable challenges of a globalised world: tapping into new foreign markets, establishing and expanding foreign production sites, but also constantly growing cost pressure. The highly dynamic nature of the business environment and international cooperation requires changes in structures and places new demands on management. As a result, international management, a better understanding of intercultural aspects and cooperation with foreign colleagues and partners, as well as the cross-border management of employees, are becoming increasingly important and are gaining greater significance in management training and the professional practice of internationally active executives. The aim of the course is to provide students with a better understanding and adequate preparation for future management tasks. This includes: • A good understanding of how different cultures influence cooperation in international projects. • Management of interdisciplinary and international projects: o Development of problem-solving skills o Knowledge acquisition through experimental learning o Team communication and understanding of dynamics o Achieving outstanding results both in writing and in the final presentation to the project sponsor.
Interdisciplinary Qualification objectives	The module contributes to an understanding of other countries/corporate cultures. The combination of an excursion/project work on site significantly promotes a sense of belonging, group identity and the ability to work together.

Contents	Real case studies (usually in collaboration with companies) are worked on by international project teams. The aim is to promote both the professional and personal development of students in the following areas. • Global internationalisation strategies • Operational topics related to cross-border/international business activities: organisational development in an international context, international human resources management, marketing and sales, global sourcing, global supply chain management, operations management • International and intercultural management • Recognising and managing complex intercultural situations and effective leadership in intercultural teams. The course is conducted in cooperation with partners (companies or universities) in neighbouring countries, which change annually. As part of the seminar, students work in project groups to solve real problems posed by companies. The seminar includes both face-to-face sessions in the UK and abroad and autonomous project work by the teams (self-organisation by the project teams). Interaction with company representatives as well as interim and final presentations are planned.
Literature	• Dülfer, E. (2011): *International Management in Different Cultural Areas.* Oldenbourg: Munich, among others. • Hill, C. (2013): *International Business – competing in the global marketplace.* McGraw-Hill: New York. • Hofstede, G., Hofstede, G. J. (2010): *Culture and organisations – Software of the mind.* McGraw-Hill: New York et al. • Trompenaars, A., Hampden-Turner, C. (2011): *Riding the waves of culture – Understanding cultural diversity in business.* Brealey: London. • Depending on the real case studies, further specialised literature may be necessary. (This usually becomes apparent during the course of the project.)
Workload	Workload: 6 ECTS x 30 hours = 180 hours. Attendance time: 4 hours per week x 15 weeks = 60 hours
Media	Project work in small groups (approx. 4 to 6 people), carried out both virtually and during attendance sessions. The attendance sessions are supplemented by lectures as required, and the project work is supervised by appropriate individual project coaching of the subgroups.

10. Managing the Value Chain

Managing the Value Chain	
Reference number	MWI10020
Semester	2nd semester
Level	Professional academic level
Credits	3
SWS	2
Related courses	MWI10022 Strategic Purchasing
Participation requirements according to SPO	Admission to the Master's programme
Recommended requirements	English B2
Examination type(s), examination duration (only for PLK/PLM)	PLH/PLR/PLP
Language of instruction	English
Module coordinator	Prof. Dr. Moritz Peter
Lecturers	Prof. Dr. Moritz Peter
Curriculum assignment	MIM English Track – compulsory subject 2nd semester, MEM – compulsory subject 1st/2nd semester
Teaching methods used in the module's courses	Lectures and seminars
Objectives	Students will learn • the fundamentals, concepts and methods of corporate procurement, • the strategic procurement process, • the key challenges in international procurement, • develop, optimise and implement purchasing strategies • evaluating and selecting suppliers, • negotiating key contract elements.
Interdisciplinary Qualification objectives	The module promotes thinking in terms of processes and workflows and helps to view, analyse, map and improve end-to-end processes from suppliers to customers from different perspectives.
Contents	Procurement marketing, procurement market research, procurement strategies in an international environment, supplier development, analysis of technical products with regard to make or buy.
Literature	• Chopra, S. (2018): *Supply Chain Management: Strategy, Planning and Operation.* 7th Edition, Pearson: London. • Heizer, J., Render, B. (2016): *Operations Management.* Global Edition, 11th Edition, Pearson: London. • Van Weele, A. J. (2014): *Purchasing and Supply Chain Management.* 6th Edition, Cengage Learning: London. • Handfield, R. B., Monczka, R. M., Giunipero, L. C., Patterson, J. L. (2016): *Sourcing and Supply Chain Management.* 6th Edition, Cengage Learning: Florence, KY. • Lecturer's lecture notes
Workload	Workload: 3 ECTS x 30 hours = 90 hours. Total attendance time: 2 hours per week x 15 weeks = 30 hours
Media	Transparencies, flipchart, projector, active board, university e-learning platform (Moodle), PC pool, example machine for learning on technical objects.

11. Capstone

"Capstone"	
Reference number	MWI10027
Semester	3rd semester
Level	Professional academic level
Credits	6
SWS	4
Related courses	MWI10028 Capstone Seminar COL6996 Specialised Scientific Colloquium
Participation requirements according to SPO	Admission to the Master's programme
Recommended prerequisites	In-depth knowledge through successful completion of lectures from all areas of the MEM curriculum.
Examination type(s), examination duration (only for PLK/PLM)	Capstone seminar: PLH/PLR/PLP Specialist colloquium: UPL
Language of instruction	German or English
Module coordinator	Prof. Dr. Ansgar Kühn
Lecturers	Capstone Seminar: Alternating lecturers from the field of industrial engineering Specialist colloquium: All full-time professors are eligible to serve as examiners.
Assignment to the curriculum	MEM, MIM – Compulsory subject, 3rd semester
Teaching methods used in the module's courses	Project work, seminar, case study seminar, individual work, preferably in collaboration with companies
Objectives	**Capstone seminar:** The MEM curriculum aims to provide students with a consecutive and generalist education, combined with their individual areas of interest and development goals. The latter are achieved through the selection of elective subjects and, in some cases, courses at partner universities abroad. At the end of their studies, all students should apply and deepen the breadth of their acquired knowledge and skills in the capstone seminar and identify interdependencies between the individual subject areas. **Specialist colloquium:** Within the framework of individual achievements, students should set individual, subject-specific priorities and address identified weaknesses. Aspects of individual career planning are given special consideration. The ability for critical self-reflection is encouraged.
Interdisciplinary qualification goals	The module contributes to teamwork and (self-)reflection skills.
Contents	**Capstone Seminar:** The seminar is designed by the supervising professors depending on the number of participants and the topics to be covered. Project work and/or case study seminars are used for this purpose. The topics, dates and proportions of attendance phases are determined at an early stage. **Specialist colloquium:** The content depends on the individual student. In particular, aspects of academic or professional qualifications, e.g. additional

	qualifications beyond the curriculum, should be taken into account here. Key topics are determined in consultation with the supervising professors.
Literature	Will be announced in good time.
Workload	Workload: 6 ECTS x 30 hours = 180 hours Of which attendance time: 4 hours per week x 15 weeks = 60 hours
Media formats	Seminar / project or interactive teaching discussion

12. Master's thesis

"Master's thesis"	
Reference number	THE6880
Semester	3rd semester
Level	Expert level
Credits	24
SWS	0
Related courses	None
Participation requirements according to SPO	The Master's thesis can be assigned at the earliest in the 2nd semester.
Recommended prerequisites	Solid technical and scientific knowledge from the Master's programme.
Type of examination(s), duration of examination (only for PLK/PLM)	PLT
Language of instruction	English
Module coordinator	Responsible professor
Lecturers	All professors in the department.
Assignment to the curriculum	MIM, MEM – compulsory subject, 3rd semester
Teaching methods used in the module's courses	Thesis
Objectives	The Master's thesis should demonstrate that students are able to independently work on an industrial engineering problem within a given time frame using scientific methods and solve it precisely and efficiently. To this end, they are able to research available scientific findings and develop their own theoretical concepts and models. They have mastered the necessary methods and procedures. They select suitable methods and apply them correctly, adapt them, develop them further and test their viability when dealing with complex problems. Students are able to critically compare their own results with other approaches and evaluate their own results. Students also demonstrate that they can clearly formulate their results and record them in writing in an academically appropriate form.
Interdisciplinary Qualification goals	Students are able to present complex topics in a differentiated manner from different perspectives and prepare them in accordance with academic standards. Through their thesis, they demonstrate their sound analytical thinking skills and critical judgement using scientific methods. They are able to plan and carry out an academic thesis project over a longer period of time, thereby demonstrating their perseverance. Students also demonstrate that they can clearly formulate their findings and present them in writing in an academically appropriate manner. Students are able to critically compare their own findings with other approaches, evaluate their own findings and thus make a significant contribution to the field of science or provide a solution with high practical relevance.

Contents	A topic that is usually related to the faculty's main areas of research is assigned to the students or, alternatively, proposed by the students. It must be related to the field of economics and/or engineering in terms of subject matter and cover subject-specific or interdisciplinary current issues and topics. Students independently research the available scientific findings, carry out their own analyses and formulate theses. They also conduct their own empirical or theoretical research work in order to achieve the objectives set for the Master's thesis. To this end, they develop their own theories and models, which they verify or refute according to scientific criteria.
Literature	Topic-specific literature, to be selected by the students.
Workload	Processing time 6 months, 24 ECTS x 30 hours = 720 hours of processing, including documentation.
Media formats	Printed and electronic copies.