



## **Module Manual**

Master of Science

# **International Production Management**

Cohort: Winter Term 2015

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## Program description

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### Content

The international master program "international production management" extends the education in engineering, mathematics and natural science of the bachelor studies. It provides systematic, scientific and autonomous problem solving capabilities needed in industry and research.

The following topics of production are covered: production technology (manufacturing, material sciences and materials processing, mechatronics and computer sciences), scientific deepening of mechanical engineering topics, production management (e.g. project management, resource management, corporate entrepreneurship, logistics).

Students specialize within two concentrations and develop the ability to work in the interfaces of the interconnected sub-disciplines. Based on personal interest, students are able to adapt their study programs within a broad catalogue of elective courses.

### Career prospects

The international master program "international production management" prepares graduates for a wide range of job profiles in production and mechanical engineering.

Graduates can work directly in their specialization area: product technology or product management.

They gain knowledge about numerous methods and about the work at interfaces between different disciplines that enables them to interdisciplinary work.

Graduates may decide for direct entry into companies or to take up academic careers, e.g. Ph.D. studies, in universities or other research institutions. In companies they can take up jobs as specialists (e.g. manufacturing or process engineer, production planner) or subsequently qualify for demanding management tasks in the technical area (e.g. project, group, or team leader; production manager or technical director).

The program is designed to be universal and allows graduates to work in a variety of different industrial sectors and with different products.

### Learning target

Graduates of the program are able to transfer the individually acquired specialized knowledge to new, unknown topics, to comprehend, to analyze and to scientifically solve complex problems of their discipline. They can find missing information and plan as well as execute theoretical and experimental studies. They are able to judge, evaluate and question scientific engineering results critically as well as making decisions based on this foundation and draw further conclusions. They are able to act methodically, to organize smaller projects, to select new technologies and scientific methods and to advance these further, if necessary.

Graduates can develop and document new ideas and solutions, independently or in teams. They are capable of presenting and discussing results to and with professionals. They can estimate their own strengths and weaknesses as well as possible consequences of their actions. They are capable of familiarizing themselves with complex tasks, defining new tasks and developing the necessary knowledge to solve them using systematically applied, appropriate means.

#### Production Technology

In the production technology specialization graduates gain knowledge about different production related topics, like material science and materials processing, mechatronic systems design, computer sciences as well as product design and computation. Graduates are able to choose and design appropriate manufacturing procedures for different product designs.

#### Management

In the management specialization graduates learn the necessary basics of business management for production. They gain knowledge about process planning as well as managing of projects or personnel. Graduates are able to evaluate the necessary business and financial key figures of production processes and to make decisions based on those.

### Program structure

The course is designed modularly and is based on the university-wide standardized course structure with uniform module sizes (multiples of six credit points (CP)).

The program combines the engineering and business sciences, production and management, and allows the deepening within these specializations.

The students can broadly personalize their studies due to the high number and variety of elective courses.

In the common core skills, students take the following modules:

- Computer Aided Design and Computation (6 CP)
- International Business (6 CP)
- Rapid Production (6 CP)
- Deepening of the production and manufacturing process foundation (12 CP)
- Nontechnical elective complementary courses (catalogue) (6 CP).

Students specialize by selecting within the following areas:

- Production Technology (18 CP),
- Management (24 CP).

Within each area of specialization modules with a size of six credits can be chosen from a module catalog. Instead, open modules can be attend to the maximum extent of six credit points, in which smaller specialized courses can be combined, individually.

Students write a master thesis and one additional scientific project work.

- Project work (12 CP)
- Master thesis (30 CP)

## Core qualification

The students gain the basic knowledge about production management, modern manufacturing processes as well as product design and computation. Non-technical electives help to improve common knowledge and German language. Students deepen their autonomous methodological and scientific problem solving skills in the field of production management or related disciplines by writing a scientific project work.

### Module M0820: International Business

#### Courses

Title	Typ	Hrs/wk	CP
Business-to-Business Marketing (L0762)	Lecture	2	2
Intercultural Management and Communication (L0846)	Lecture	2	2
International Management (L0157)	Lecture	2	2

<b>Module Responsible</b>	Prof. Christian Lüthje
<b>Admission Requirements</b>	None
<b>Recommended Previous Knowledge</b>	<p>Bachelor-level knowledge in marketing and (international) strategic management; basic understanding of market segmentation, modes of market entry, strategic management, pricing theory and marketing instruments.</p> <p>The previous knowledge which is required for this module is taught by e-learning modules. Students receive access data and former information regarding the online content after enrolment at TUHH.</p>
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results
<b>Professional Competence</b>	<p><i>Knowledge</i></p> <p>The students will develop a thorough understanding of the following:</p> <ul style="list-style-type: none"> <li>• Selling to organizations and marketing strategies in B2B markets</li> <li>• Relevant theories, methods and tools for operational B2B marketing</li> <li>• Relevant theories for intercultural communication</li> <li>• Theoretical knowledge of               <ul style="list-style-type: none"> <li>◦ the importance of globalization for firms and the challenges facing companies in the context of their international operations;</li> <li>◦ methods of measuring the internationalization degree of companies and the resulting practical implications;</li> <li>◦ target market strategies, market entry strategies and foreign operation modes and allocation strategies;</li> <li>◦ different types of international organizational structures (e.g. global organization, network organization, transnational organization);</li> <li>◦ "culture" and its impact on human interaction;</li> <li>◦ important aspects of (intercultural) communication issues.</li> <li>◦ methods of analysis and assessment of market entry risks by applying modern theories such as the "Innovator's Dilemma" framework;</li> <li>◦ modes of cooperation such as prime contractor and consortium models and their industrial cooperation related advantages and disadvantages;</li> <li>◦ special methods of assessment of specific country risks;</li> </ul> </li> </ul> <p><i>Skills</i></p> <p>The students will be able to apply this knowledge to</p> <ul style="list-style-type: none"> <li>• identify and systematically address relevant partners when selling to business organizations;</li> <li>• place, price and communicate industrial products with the help state-of-the-art B2B marketing tools;</li> <li>• define the specifics of global industries and respond to them deriving appropriate practical recommendations (global competitors, regional consumers, local and global suppliers, etc.);</li> <li>• derive advantages and disadvantages of different target market, market entry, timing and allocation strategies;</li> <li>• apply the theoretical knowledge to business cases or real examples (e.g. internationalization processes of well-known hotel chains or franchise companies, etc.);</li> <li>• interpret symbols, rituals and gestures appropriately in an intercultural context.</li> </ul> <p><b>Based on these skills, the students will be able to</b></p> <ul style="list-style-type: none"> <li>• analyze market-entry options and market positioning in B2B markets;</li> <li>• systematically analyze, work up and present information needed for making the decision for or against internationalization of company's operations and regarding HOW, WHEN and WHAT;</li> <li>• analyze and evaluate risks in the context of international business operations;</li> <li>• decide which mode of market entry (e.g. franchising) yields most potential;</li> <li>• make methodically based internationalization decisions as well as master the specifics of strategic management in an international context and apply concrete planning processes;</li> <li>• develop strategies when approaching international client companies and manage relationships with complex client entities;</li> <li>• develop sophisticated market-entry strategies and to position innovative industrial goods in global business-to-business markets;</li> <li>• develop communication strategies in the domain of industrial goods, develop pricing plans by applying state-of-the-art tools like Vickrey-auctions to measure willingness-to-pay and methods such as tender-bidding models.</li> <li>• solve complex operating planning tasks independently or in a team applying appropriate methods and comprehensibly present the results of their analysis;</li> <li>• identify problems and resolve cultural issues in multi-cultural teams and in intercultural collaborations</li> <li>• successfully manage cultural diversity.</li> </ul>



Course L0762: Business-to-Business Marketing	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christian Lühje
Language	EN
Cycle	WiSe
Content	<p><b>Contents</b></p> <p>Business-to-business (B2B) markets play an important role in most economies. At the same time, B2B markets differ strongly from consumer goods markets. For example, companies' buying decisions follow different rules than those of consuming individuals. Consequently, marketing mix decisions in B2B markets need to follow the specific circumstances in such markets.</p> <p>The aim of this lecture is to enable students to understand the specifics of marketing in B2B markets. At the beginning, students learn which strategic marketing decisions may be most appropriate in industrial markets. Following that, the lecture will focus more on different options to design marketing mix elements – Pricing, Communication and Distribution – in B2B markets. We extend the student's basic knowhow in marketing and focus on the specific requirements in B2B markets.</p> <p>Topics</p> <ul style="list-style-type: none"> <li>• The importance, specific characteristics and developments of B2B markets today</li> <li>• Organizational buying behavior and the corporate buying process</li> <li>• B2B marketing strategies regarding modes and time of market entry with focus on innovative industrial products</li> <li>• Types of project-related cooperation in the B2B project business</li> <li>• Specific operational marketing methods in communication (success factors of fairs and exhibitions, importance of public relations for B2B markets); pricing (measuring willingness-to-pay via auctions; value-based pricing in industrial markets, bidding models and auctioning); distribution and channel strategies for B2B markets</li> <li>• Marketing in complex value chains: Solving the problem of direct customers' unwillingness to adopt innovative products by directly addressing indirect customers</li> </ul> <p><b>Knowledge</b></p> <p>The students will develop a thorough understanding of:</p> <ul style="list-style-type: none"> <li>• How organizations and firms buy</li> <li>• How marketing can be performed in complex value chains</li> <li>• Promising market and competitive strategies in B2B markets</li> <li>• Modes of cooperation in B2B markets</li> <li>• Marketing-Mix decisions in B2B marketing (communication, pricing, distribution)</li> </ul> <p><b>Skills</b></p> <ul style="list-style-type: none"> <li>• analyzing the advantages and disadvantages of different target market, market entry, timing and allocation strategies;</li> <li>• identifying and systematically address relevant partners when selling to business organizations;</li> <li>• developing context-specific market-entry and timing strategies;</li> <li>• making appropriate decisions for the pricing and communication of industrial products;</li> <li>• applying the theoretical knowledge to business cases or real examples</li> </ul> <p><b>Social Competence</b></p> <p>The students will be able to</p> <ul style="list-style-type: none"> <li>• having fruitful professional discussions;</li> <li>• presenting and defending the results of their work in groupwork;</li> </ul> <p><b>Self-reliance</b></p> <ul style="list-style-type: none"> <li>• acquiring knowledge in the specific context independently and to map this knowledge onto other new complex problem fields.</li> </ul> <p><b>Assessment</b></p> <p>Written examination &amp; Class participation in interactive elements (presentations, homework)</p>
Literature	<p>Blythe, J., Zimmerman, A. (2005) Business-to-Business Marketing: A global perspective, London, Thomson</p> <p>Monroe, K. B. (2002). Pricing: Making Profitable Decisions, 3<sup>rd</sup> Edition</p> <p>Morris, M., Pitt, L., Honeycutt, E. (2001), Business-to-Business Marketing, New York, Sage Publishing, 3rd Edition</p> <p>Nagle, T., Hogan, J., Zale, J. (2009), Strategy and Tactics of Pricing, New York, Prentice Hall, 5th Edition</p>

Course L0846: Intercultural Management and Communication	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Dr. Rajnish Tiwari
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	<p>Globalization of business processes and the revolution in information and communication technologies (ICT) have resulted in distributed workflows across geographic boundaries. These developments as well as increased immigration emanating, for example, as a consequence of a shortage of skilled labour in many industrialized nations, have led to the creation of (virtual) multi-cultural, multi-ethnic teams with diverse cultural backgrounds. Such diversity generally has a positive impact on creativity and innovativeness, as many empirical studies confirm. Nevertheless, varying cultural practices, communication styles, and contextual sensibilities have the potential to disturb or even disrupt collaborative work processes, if left unmanaged.</p> <p>This course focuses on inter-cultural management from both, theoretical as well as practical, points of view to provide a solid fundament to students enabling them to operate successfully in cross-cultural settings. Case studies and guest lecture(s) will be used to provide added practical relevance to the course. In addition, where practicable, student assignments will be used to foster autonomous learning.</p> <p>Some of the main topics covered in this course include:</p> <ul style="list-style-type: none"> <li>• Understanding "culture" and its impact on human interaction</li> <li>• Verbal and non-verbal communication</li> <li>• High and low context communication</li> <li>• Role of formality and non-formality in communication</li> <li>• Varying interpretations of symbols, rituals &amp; gestures</li> <li>• Managing diversity in domestic settings</li> </ul>
<b>Literature</b>	<ul style="list-style-type: none"> <li>• Bartlett, C.A. / Ghoshal, S. (2002): Managing Across Borders: The Transnational Solution, 2<sup>nd</sup> edition, Boston</li> <li>• Deresky, H. (2006): International Management: Managing Across Borders and Cultures, 3<sup>rd</sup> edition, Upper Saddle River</li> <li>• French, R. (2010): Cross-cultural Management in Work Organisations, 2<sup>nd</sup> edition, London</li> <li>• Hofstede, G. (2003): Culture's Consequences : Comparing Values, Behaviors, Institutions and Organizations across Nations, 2<sup>nd</sup> edition, Thousand Oaks</li> <li>• Hofstede, G. / Hofstede, G.J. (2006): Cultures and Organizations: Software of the mind, 2<sup>nd</sup> edition, New York</li> </ul>

Course L0157: International Management	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Thomas Wrona
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	<p>Growing internationalization of companies and increased globalization require dealing with operations and specifics of international management as well as creating an understanding of intercultural differences. In order to help the students to understand these specifics and challenges accompanying international companies, the course will be divided in the following parts:</p> <ul style="list-style-type: none"> <li>• Important Aspects in International Management</li> <li>• Theories of Internationalization</li> <li>• Specific characteristics of international companies and their strategies</li> <li>• Organizational Structure and Leadership in international companies</li> </ul> <p>During the course, the content will be covered from a theoretical as well as a practical point of view by using examples of different companies. In order to provide practical relevance to the course, a guest speaker from a well-known international company will be invited or alternatively a company visit will be organized as well as an analysis of a case study will take place.</p>
<b>Literature</b>	<ol style="list-style-type: none"> <li>1. Course notes and materials provided before the lecture.</li> <li>2. Selected books:           <ul style="list-style-type: none"> <li>◦ Bartlett/Ghoshal (2002): Managing Across Borders, The Transnational Solution, 2nd edition, Boston</li> <li>◦ Buckley, P.J./Ghauri, P.N. (1998), The Internationalization of the Firm, 2nd edition</li> <li>◦ Czinkota, Ronkainen, Moffett, Marinova, Marinov (2009), International Business, Hoboken</li> <li>◦ Dunning, J.H. (1993), The Globalization of Business: The Challenge of the 1990s, London</li> <li>◦ Ghoshal, S. (1987), Global Strategy: An Organizing Framework, Strategic Management Journal, p. 425-440</li> <li>◦ Praveen Parboteeah, K., Cullen, J.B. (2011), Strategic International Management, International 5th Edition</li> <li>◦ Rugman, A.M./Collinson, S. (2012): International Business, 6th Edition, Essex 2012</li> </ul> </li> </ol>



Module M1264: Technical Complementary Course Core Studies for IMPIPM (according to Subject Specific Regulations)			
Courses			
Title	Typ	Hrs/wk	CP
<b>Module Responsible</b>	Prof. Dieter Krause		
<b>Admission Requirements</b>	None		
<b>Recommended Previous Knowledge</b>	see selected module according to FSPO		
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results		
<b>Professional Competence</b>			
<i>Knowledge</i>	see selected module according to FSPO		
<i>Skills</i>	see selected module according to FSPO		
<b>Personal Competence</b>			
<i>Social Competence</i>	see selected module according to FSPO		
<i>Autonomy</i>	see selected module according to FSPO		
<b>Workload in Hours</b>	Independent Study Time 180, Study Time in Lecture 0		
<b>Credit points</b>	6		
<b>Examination</b>	according to Subject Specific Regulations		
<b>Examination duration and scale</b>			
<b>Assignment for the Following Curricula</b>	International Production Management: Core qualification: Elective Compulsory		

Module M0524: Nontechnical Elective Complementary Courses for Master	
<b>Module Responsible</b>	Dagmar Richter
<b>Admission Requirements</b>	None
<b>Recommended Previous Knowledge</b>	None
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results
<b>Professional Competence</b> <i>Knowledge</i>	<p><b>The Non-technical Elective Study Area</b></p> <p>imparts skills that, in view of the TUHH's training profile, professional engineering studies require but are not able to cover fully. Self-reliance, self-management, collaboration and professional and personnel management competences. The department implements these training objectives in its <b>teaching architecture</b>, in its <b>teaching and learning arrangements</b>, in <b>teaching areas</b> and by means of teaching offerings in which students can qualify by opting for <b>specific competences</b> and a <b>competence level</b> at the Bachelor's or Master's level. The teaching offerings are pooled in two different catalogues for nontechnical complementary courses.</p> <p><b>The Learning Architecture</b></p> <p>consists of a cross-disciplinarily study offering. The centrally designed teaching offering ensures that courses in the "non-technical department" follow the specific profiling of TUHH degree courses.</p> <p>The learning architecture demands and trains independent educational planning as regards the individual development of competences. It also provides orientation knowledge in the form of "profiles".</p> <p>The subjects that can be studied in parallel throughout the student's entire study program - if need be, it can be studied in one to two semesters. In view of the adaptation problems that individuals commonly face in their first semesters after making the transition from school to university and in order to encourage individually planned semesters abroad, there is no obligation to study these subjects in one or two specific semesters during the course of studies.</p> <p><b>Teaching and Learning Arrangements</b></p> <p>provide for students, separated into B.Sc. and M.Sc., to learn with and from each other across semesters. The challenge of dealing with interdisciplinarity and a variety of stages of learning in courses are part of the learning architecture and are deliberately encouraged in specific courses.</p> <p><b>Fields of Teaching</b></p> <p>are based on research findings from the academic disciplines cultural studies, social studies, arts, historical studies, communication studies and sustainability research, and from engineering didactics. In addition, from the winter semester 2014/15 students on all Bachelor's courses will have the opportunity to learn about business management and start-ups in a goal-oriented way.</p> <p>The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging goal-oriented communication skills, e.g. the skills required by outgoing engineers in international and intercultural situations.</p> <p><b>The Competence Level</b></p> <p>of the courses offered in this area is different as regards the basic training objective in the Bachelor's and Master's fields. These differences are reflected in the practical examples used, in content topics that refer to different professional application contexts, and in the higher scientific and theoretical level of abstraction in the B.Sc.</p> <p>This is also reflected in the different quality of soft skills, which relate to the different team positions and different group leadership functions of Bachelor's and Master's graduates in their future working life.</p> <p><b>Specialized Competence (Knowledge)</b></p> <p>Students can</p> <ul style="list-style-type: none"> <li>• explain specialized areas in context of the relevant non-technical disciplines,</li> <li>• outline basic theories, categories, terminology, models, concepts or artistic techniques in the disciplines represented in the learning area,</li> <li>• different specialist disciplines relate to their own discipline and differentiate it as well as make connections,</li> <li>• sketch the basic outlines of how scientific disciplines, paradigms, models, instruments, methods and forms of representation in the specialized sciences are subject to individual and socio-cultural interpretation and historicity,</li> <li>• Can communicate in a foreign language in a manner appropriate to the subject.</li> </ul>
<b>Skills</b>	<p><b>Professional Competence (Skills)</b></p> <p>In selected sub-areas students can</p> <ul style="list-style-type: none"> <li>• apply basic and specific methods of the said scientific disciplines,</li> <li>• question a specific technical phenomena, models, theories from the viewpoint of another, aforementioned specialist discipline,</li> <li>• to handle simple and advanced questions in aforementioned scientific disciplines in a successful manner,</li> <li>• justify their decisions on forms of organization and application in practical questions in contexts that go beyond the technical relationship to the subject.</li> </ul>
<b>Personal Competence</b>	



Module M0809: Computer Aided Design and Computation				
<b>Courses</b>				
<b>Title</b>		<b>Typ</b>	<b>Hrs/wk</b>	<b>CP</b>
Computer Aided Design and Computation (L0525)		Lecture	2	3
Computer Aided Design and Computation (L0527)		Recitation Section (small)	2	3
<b>Module Responsible</b>	Dr. Stephan Lippert			
<b>Admission Requirements</b>				
<b>Recommended Previous Knowledge</b>	<ul style="list-style-type: none"> <li>- Mechanical parts and basic operations of manufacturing techniques</li> <li>- Basic knowledge in mathematics, physics, and statics</li> <li>- Mechanics I (statics, mechanics of materials) and mechanics II (hydrostatics, kinematics, dynamics)</li> <li>- Mathematics I, II, III (in particular differential equations)</li> </ul>			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results			
<b>Professional Competence</b>	<ul style="list-style-type: none"> <li>- Understanding of the capabilities and limitations of 3D-CAD-Systems, PDM systems, and computer aided simulation Tools</li> <li>- General knowledge of the finite element method in combination with a basic theoretical and methodology basis</li> <li>- Basic understanding of the structural optimizations potential and fields of application</li> </ul>			
<i>Knowledge</i>				
<b>Skills</b>				
<i>Autonomy</i>				
<b>Personal Competence</b>	<ul style="list-style-type: none"> <li>- Hands-on practice with an exemplary 3D-CAD-system to demonstrate basic modeling techniques as well as interfaces for concurrent finite element analysis</li> </ul>			
<i>Social Competence</i>				
<i>Autonomy</i>				
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56			
<b>Credit points</b>	6			
<b>Examination</b>	Written exam			
<b>Examination duration and scale</b>	120 min			
<b>Assignment for the Following Curricula</b>	International Production Management: Core qualification: Compulsory			

Course L0525: Computer Aided Design and Computation	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Dr. Stephan Lippert, Prof. Dieter Krause, Prof. Claus Emmelmann
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	<p><b>Part 1: Computer aided design (Prof. Dr.-Ing. D. Krause)</b></p> <ul style="list-style-type: none"> <li>• Introduction to integrated product development</li> <li>• 3D-CAD-systems and CAD-interfaces</li> <li>• Introduction to PDM-systems</li> <li>• Additional computer aided engineering/simulation tools (FEA, DMU, VR)</li> </ul> <p><b>Part 2: Introduction to the Finite Element Method (Dr.-Ing. S. Lippert)</b></p> <ul style="list-style-type: none"> <li>• General overview on the finite element method</li> <li>• Displacement method</li> <li>• Isoparametric elements</li> <li>• Numerical integration</li> <li>• Applications</li> <li>• Programming of elements (Matlab, hands-on sessions)</li> </ul> <p><b>Part 3: Structural Optimization Methods (Prof. Dr.-Ing. C. Emmelmann)</b></p> <ul style="list-style-type: none"> <li>• Introduction to structural optimization theory</li> <li>• Fields of application for structural optimization and commercial software tools</li> </ul> <p>This module relies heavily on the interconnection of theory and the application of commercial software systems via live demonstrations as well as hands-on sessions in a PC-pool.</p>
<b>Literature</b>	<p>Lee, K.: Principles of CAD / CAM / CAE Systems, Addison Wesley</p> <p>Bathe, K.-J.: Finite element procedures, Prentice Hall</p> <p>Christensen, P.W.; Klarbring, A.: An introduction to structural optimization; Springer</p>

Course L0527: Computer Aided Design and Computation	
<b>Typ</b>	Recitation Section (small)
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Dr. Stephan Lippert, Prof. Dieter Krause, Prof. Claus Emmelmann
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

Module M1256: Rapid Production				
<b>Courses</b>				
<b>Title</b>		<b>Typ</b>	<b>Hrs/wk</b>	<b>CP</b>
Rapid Production (L1128)		Lecture	2	3
Rapid Production (L1129)		Seminar	2	3
<b>Module Responsible</b>	Prof. Claus Emmelmann			
<b>Admission Requirements</b>	Bachelor			
<b>Recommended Previous Knowledge</b>	<ul style="list-style-type: none"> <li>• Production Engineering</li> <li>• Fundamental of Material Science</li> <li>• Fundamentals of Mechanical Engineering Design</li> </ul>			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results			
<b>Professional Competence</b>	<p><i>Knowledge</i> Students will be able to:</p> <ul style="list-style-type: none"> <li>• give an overview of Additive Manufacturing Technologies, namely</li> <li>• describe basics of Laser Technologies</li> <li>• discuss laser Additive Manufacturing, specifically</li> <li>• design Guidelines for Additive Manufacturing</li> <li>• describe the Digital Process Chain for Additive Manufacturing</li> <li>• discuss Quality Assurance for Additive Manufacturing</li> <li>• describe Product Development for Additive Manufacturing</li> </ul> <p><i>Skills</i> The students will be able to:</p> <ul style="list-style-type: none"> <li>• give an overview of Potential and Challenges of Additive Manufacturing Technologies</li> <li>• show that Additive Manufacturing offers new possibilities for product development</li> <li>• show major differences between Additive Manufacturing and conventional manufacturing technologies</li> <li>• apply basic skills to develop and design Additive Manufacturing parts</li> <li>• design and build own Additive Manufacturing parts</li> </ul>			
<b>Personal Competence</b>	<p><i>Social Competence</i> Students are able to</p> <ul style="list-style-type: none"> <li>• interact within a team</li> <li>• organize workload in a team</li> </ul> <p><i>Autonomy</i> Students are able to</p> <ul style="list-style-type: none"> <li>• develop and optimize a product with limited resources, based on defined requirements</li> <li>• present results skillfully</li> </ul>			
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56			
<b>Credit points</b>	6			
<b>Examination</b>	Written exam			
<b>Examination duration and scale</b>	75 min			
<b>Assignment for the Following Curricula</b>	International Production Management: Core qualification: Compulsory			

Course L1128: Rapid Production	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Claus Emmelmann
<b>Language</b>	EN
<b>Cycle</b>	SoSe
<b>Content</b>	<p>Learn the Basics of Additive Manufacturing, with focus on the Selective Laser Melting and Selective Laser Sintering. Understand the advantages the technologies offer for product development and what current challenges Additive Manufacturing faces. Get to know the design restrictions as well as basic knowledge about material characteristics, post processing and quality assurance.</p> <p><b>This lecture is part of the Module Rapid Production and cannot be chosen separately</b></p>
<b>Literature</b>	Will be announced during the course

Course L1129: Rapid Production	
<b>Typ</b>	Seminar
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Claus Emmelmann
<b>Language</b>	EN
<b>Cycle</b>	SoSe
<b>Content</b>	<p>Intensify learning from the lecture, especially regarding design principles and product development by design of own Selective Laser Sintering parts.</p> <p><b>This seminar is part of the Module Rapid Production and cannot be chosen separately.</b></p>
<b>Literature</b>	Will be announced during the course

Module M1257: 3D Printing Laboratory				
<b>Courses</b>				
<b>Title</b>		<b>Typ</b>	<b>Hrs/wk</b>	<b>CP</b>
3D Printing Laboratory (L1701)		Laboratory Course	3	6
<b>Module Responsible</b>	Prof. Claus Emmelmann			
<b>Admission Requirements</b>	None			
<b>Recommended Previous Knowledge</b>	Rapid Production Computer Aided Design and Computation			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results			
<b>Professional Competence</b>				
<i>Knowledge</i>	Students will be able to give an overview over <ul style="list-style-type: none"> <li>• 3D printing based on fused deposition modeling,</li> <li>• printer setup and hardware components,</li> <li>• software and CAD data preparation,</li> <li>• and process parameters and quality aspects.</li> </ul>			
<i>Skills</i>	The students will be able to <ul style="list-style-type: none"> <li>• prepare CAD models for 3D printing,</li> <li>• calibrate and operate a 3D printer,</li> <li>• conduct designed experiments,</li> <li>• and find optimal printing parameters.</li> </ul>			
<b>Personal Competence</b>				
<i>Social Competence</i>	The students will be able to <ul style="list-style-type: none"> <li>• coordinate work in a team,</li> <li>• set up, monitor and adapt a project plan,</li> <li>• share information with team members,</li> <li>• deal with different personal knowledge backgrounds,</li> <li>• and handle team conflicts.</li> </ul>			
<i>Autonomy</i>	Without external support the students will be able to <ul style="list-style-type: none"> <li>• do literature research,</li> <li>• organize work according to a schedule,</li> <li>• conduct experiments,</li> <li>• and operate and troubleshoot a production machine.</li> </ul>			
<b>Workload in Hours</b>	Independent Study Time 138, Study Time in Lecture 42			
<b>Credit points</b>	6			
<b>Examination</b>	Written elaboration			
<b>Examination duration and scale</b>	ca. 30 pages, approximately eight hours of preparation			
<b>Assignment for the Following Curricula</b>	International Production Management: Core qualification: Elective Compulsory Mechanical Engineering and Management: Specialisation Product Development and Production: Elective Compulsory			

Course L1701: 3D Printing Laboratory	
<b>Typ</b>	Laboratory Course
<b>Hrs/wk</b>	3
<b>CP</b>	6
<b>Workload in Hours</b>	Independent Study Time 138, Study Time in Lecture 42
<b>Lecturer</b>	Prof. Claus Emmelmann
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	The 3D Printing lab consists of: <ul style="list-style-type: none"> <li>· Preparation of CAD models for 3D printing,</li> <li>· Design of Experiments for 3D-printing</li> <li>· Hands-on operation of 3D printer</li> <li>· Printing parameter variation and detection of influences on the process</li> </ul>
<b>Literature</b>	wird in der Veranstaltung bekannt gegeben



Module M1258: Laser Systems and Metallic Materials			
<b>Courses</b>			
<b>Title</b>	<b>Typ</b>	<b>Hrs/wk</b>	<b>CP</b>
Laser Systems and Process Technologies (L1612)	Lecture	2	3
Structural Metallic Materials (L1702)	Lecture	2	3
<b>Module Responsible</b>	Prof. Claus Emmelmann		
<b>Admission Requirements</b>	Bachelor		
<b>Recommended Previous Knowledge</b>	Fundamentals of Materials Science I		
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results		
<b>Professional Competence</b>	<p><i>Knowledge</i></p> <p>Students can give an overview over laser systems for material processing, specifically:</p> <ul style="list-style-type: none"> <li>• beam sources,</li> <li>• transport and manipulation of Laser beams,</li> <li>• and laser Safety.</li> </ul> <p>They can also describe applications of laser systems in material processing, namely:</p> <ul style="list-style-type: none"> <li>• primary forming,</li> <li>• marking,</li> <li>• cutting,</li> <li>• joining,</li> <li>• and surface treatment.</li> </ul> <p>They can also explain the material science of technically relevant metals as for example</p> <ul style="list-style-type: none"> <li>• carbon steels,</li> <li>• micro alloyed steels</li> <li>• low- and high-alloyed steels,</li> <li>• stainless steels,</li> <li>• aluminium alloys,</li> <li>• and magnesium alloys.</li> </ul> <p><i>Skills</i></p> <p>After successful completion of this course, students should be able to</p> <ul style="list-style-type: none"> <li>• give an overview on current laser technology,</li> <li>• classify its applications in today's manufacturing processes,</li> <li>• evaluate economical and quality aspects,</li> <li>• find suitable laser systems for given tasks.</li> </ul> <p><b>Personal Competence</b></p> <p><i>Social Competence</i></p> <ul style="list-style-type: none"> <li>• Students are able to discuss their solutions to problems with others. They communicate in English.</li> </ul> <p><i>Autonomy</i></p> <ul style="list-style-type: none"> <li>• Students are able of checking their understanding of complex concepts by solving variants of concrete problems</li> </ul>		
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56		
<b>Credit points</b>	6		
<b>Examination</b>	Written elaboration		
<b>Examination duration and scale</b>	approx. 20 pages		
<b>Assignment for the Following Curricula</b>	International Production Management: Core qualification: Elective Compulsory Mechanical Engineering and Management: Specialisation Product Development and Production: Elective Compulsory		

Course L1612: Laser Systems and Process Technologies	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Claus Emmelmann
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• Fundamentals of laser technology</li> <li>• Laser beam sources: CO<sub>2</sub>-, Nd:YAG-, Fiber- and Diodelasers</li> <li>• Laser system technology: beam forming, beam guidance systems, beam motion and beam control</li> <li>• Laser-based manufacturing technologies: generation, marking, cutting, joining, surface treatment</li> <li>• Quality assurance and economical aspects of laser material processing</li> <li>• Markets and Applications of laser technology</li> <li>• Student group exercises</li> </ul>
<b>Literature</b>	<ul style="list-style-type: none"> <li>• Hgel, H. , T. Graf: Laser in der Fertigung : Strahlquellen, Systeme, Fertigungsverfahren, 3. Aufl., Vieweg + Teubner Wiesbaden 2014.</li> <li>• Eichler, J., Eichler. H. J.: Laser: Bauformen, Strahlfhrung, Anwendungen, 7. Aufl., Springer-Verlag Berlin Heidelberg 2010.</li> <li>• Steen W. M.; Mazumder J.: Laser material processing, 4th Edition, Springer-Verlag London 2010.</li> <li>• J.C. Ion: Laser processing of engineering materials: principles, procedure and industrial applications, Elsevier Butterworth-Heinemann 2005.</li> <li>• Gebhardt, A.: Understanding additive manufacturing, Mnchen [u.a.] Hanser 2011</li> </ul>

Course L1702: Structural Metallic Materials	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Karl-Ulrich Kainer
Language	EN
Cycle	WiSe
Content	<p>Steels:</p> <ul style="list-style-type: none"> <li>• Fundamentals of steels</li> <li>• Carbon steels: phase diagram, transformation behaviour, technical heat treatments</li> <li>• Low and high alloyed steels: influence of alloying elements on transformation and carbides</li> <li>• Micro alloyed steels</li> <li>• Corrosion and scaling resistant steels : Classification, composition and microstructure, properties and applications</li> </ul> <p>Aluminium alloys:</p> <ul style="list-style-type: none"> <li>• Alloy systems and groups</li> <li>• Non-age-hardenable Al-alloys: Processing and microstructure, Mechanical properties and applications</li> <li>• Age-hardenable Al-alloys: Processing and microstructure, Mechanical properties and applications</li> </ul> <p>Titanium alloys</p> <ul style="list-style-type: none"> <li>• Introduction into titanium materials, alloy systems and groups</li> <li>• Processing, microstructure and properties</li> <li>• Applications</li> </ul> <p>Magnesium alloys</p> <ul style="list-style-type: none"> <li>• Introduction into magnesium materials, Alloy systems and groups</li> <li>• Cast alloys, processing, microstructure and properties</li> </ul> <p>Wrought alloys, processing, microstructure and properties</p>
Literature	<ul style="list-style-type: none"> <li>• George Krauss, Steels: Processing, Structure, and Performance, 978-0-87170-817-5, 2006,</li> <li>• Hans Berns, Werner Theisen, Ferrous Materials: Steel and Cast Iron, 2008. <a href="http://dx.doi.org/10.1007/978-3-540-71848-2">http://dx.doi.org/10.1007/978-3-540-71848-2</a></li> <li>• C. W. Wegst, Stahlschlüssel = Key to steel = La Clé des aciers = Chiave dell'acciaio = Liave del acero ISBN/ISSN: 3922599095</li> <li>• Bruno C., De Cooman / John G. Speer: Fundamentals of Steel Product Physical Metallurgy, 2011, 642 S.</li> <li>• Harry Chandler, Steel Metallurgy for the Non-Metallurgist 0-87170-652-0, 2006, 84 S.</li> <li>• Catrin Kammer, Aluminium Taschenbuch 1, Grundlagen und Werkstoffe, Beuth,16. Auflage 2009. 784 S., ISBN 978-3-410-22028-2</li> <li>• Günter Drossel, Susanne Friedrich, Catrin Kammer und Wolfgang Lehnert, Aluminium Taschenbuch 2, Umformung von Aluminium-Werkstoffen, Gießen von Aluminiumteilen, Oberflächenbehandlung von Aluminium, Recycling und Ökologie, Beuth, 16. Auflage 2009. 768 S., ISBN 978-3-410-22029-9</li> <li>• Catrin Kammer, Aluminium Taschenbuch 3, Weiterverarbeitung und Anwendung, Beuth,17. Auflage 2014. 892 S., ISBN 978-3-410-22311-5</li> <li>• G. Lütjering, J.C. Williams: Titanium, 2nd ed., Springer, Berlin, Heidelberg, 2007, ISBN 978-3-540-71397</li> <li>• Magnesium - Alloys and Technologies, K. U. Kainer (Hrsg.), Wiley-VCH, Weinheim 2003, ISBN 3-527-30570-x</li> <li>• Mihriban O. Pekguleryuz, Karl U. Kainer and Ali Kaya "Fundamentals of Magnesium Alloy Metallurgy", Woodhead Publishing Ltd, 2013,ISBN 10: 0857090887</li> </ul>

Module M1252: Research Project International Production Management			
Courses			
Title	Typ	Hrs/wk	CP
<b>Module Responsible</b>	Dozenten des Studiengangs		
<b>Admission Requirements</b>	none		
<b>Recommended Previous Knowledge</b>	Subjects of the Master program and the specialisations.		
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results		
<b>Professional Competence</b>	<p><i>Knowledge</i></p> <ul style="list-style-type: none"> <li>• Students can explain the project as well as their autonomously gained knowledge and relate it to current issues of their field of study.</li> <li>• They can explain the basic scientific methods they have worked with.</li> </ul> <p><i>Skills</i></p> <p>The students are able to autonomously solve a limited scientific task under the guidance of an experienced researcher. They can justify and explain their approach for problem solving; they can draw conclusions from their results, and then can find new ways and methods for their work. Students are capable of comparing and assessing alternative approaches with their own with regard to given criteria.</p> <p><b>Personal Competence</b></p> <p><i>Social Competence</i></p> <p>The students are able to condense the relevance and the structure of the project work, the work procedure and the sub-problems for the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to their peers and supervisors.</p> <p><i>Autonomy</i></p> <p>The students are capable of independently planning and documenting the work steps and procedures while considering the given deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain feedback from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology.</p>		
<b>Workload in Hours</b>	Independent Study Time 360, Study Time in Lecture 0		
<b>Credit points</b>	12		
<b>Examination</b>	Project (accord. to Subject Specific Regulations)		
<b>Examination duration and scale</b>			
<b>Assignment for the Following Curricula</b>	International Production Management: Core qualification: Compulsory		



Course L0849: Technology Management	
<b>Typ</b>	Problem-based Learning
<b>Hrs/wk</b>	3
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 48, Study Time in Lecture 42
<b>Lecturer</b>	Prof. Cornelius Herstatt
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	<p>The role of technology for the competitive advantage of the firm and industries; Basic concepts, models and tools for the management of technology; managerial decision making regarding the identification, selection and protection of technology (make or buy, keep or sell, current and future technologies). Theories, practical examples (cases), lectures, interactive sessions and group study.</p> <p>This lecture is part of the Module Technology Management and can not separately choosen.</p>
<b>Literature</b>	Leiblein, M./Ziedonis, A.: Technology Strategy and Inoovation Management, Elgar Research Collection, Northhampton (MA) 2011

Course L0850: Technology Management Seminar	
<b>Typ</b>	Problem-based Learning
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Cornelius Herstatt
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	Aspects of and Cases in combination with the content of the lecture.
<b>Literature</b>	see lecture Technology Management.

Module M0815: Product Planning				
<b>Courses</b>				
<b>Title</b>		<b>Typ</b>	<b>Hrs/wk</b>	<b>CP</b>
Product Planning (L0851)		Problem-based Learning	3	3
Product Planning Seminar (L0853)		Problem-based Learning	2	3
<b>Module Responsible</b>	Prof. Cornelius Herstatt			
<b>Admission Requirements</b>	None			
<b>Recommended Previous Knowledge</b>	Good basic-knowledge of Business Administration			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results			
<b>Professional Competence</b>				
<i>Knowledge</i>	Students will gain insights into:			
	<ul style="list-style-type: none"> <li>• Product Planning               <ul style="list-style-type: none"> <li>◦ Process</li> <li>◦ Methods</li> </ul> </li> <li>• Design thinking               <ul style="list-style-type: none"> <li>◦ Process</li> <li>◦ Methods</li> <li>◦ User integration</li> </ul> </li> </ul>			
<i>Skills</i>	Students will gain deep insights into:			
	<ul style="list-style-type: none"> <li>• Product Planning               <ul style="list-style-type: none"> <li>◦ Process-related aspects</li> <li>◦ Organisational-related aspects</li> <li>◦ Human-Ressource related aspects</li> <li>◦ Working-tools, methods and instruments</li> <li>◦</li> </ul> </li> </ul>			
<b>Personal Competence</b>				
<i>Social Competence</i>	<ul style="list-style-type: none"> <li>• Interact within a team</li> <li>• Raise awareness for globabl issues</li> </ul>			
<i>Autonomy</i>	<ul style="list-style-type: none"> <li>• Gain access to knowledge sources</li> <li>• Interpret complex cases</li> <li>• Develop presentation skills</li> </ul>			
<b>Workload in Hours</b>	Independent Study Time 110, Study Time in Lecture 70			
<b>Credit points</b>	6			
<b>Examination</b>	Written exam			
<b>Examination duration and scale</b>	90 minutes			
<b>Assignment for the Following Curricula</b>	Global Innovation Management: Core qualification: Compulsory International Production Management: Specialisation Management: Elective Compulsory International Management and Engineering: Specialisation I. Electives Management: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory			

Course L0851: Product Planning	
<b>Typ</b>	Problem-based Learning
<b>Hrs/wk</b>	3
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 48, Study Time in Lecture 42
<b>Lecturer</b>	Prof. Cornelius Herstatt
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	<p>Product Planning Process</p> <p>This integrated lecture is designed to understand major issues, activities and tools in the context of systematic product planning, a key activity for managing the front-end of innovation, i.e.:</p> <ul style="list-style-type: none"> <li>• Systematic scanning of markets for innovation opportunities</li> <li>• Understanding strengths/weakness and specific core competences of a firm as platforms for innovation</li> <li>• Exploring relevant sources for innovation (customers, suppliers, Lead Users, etc.)</li> <li>• Developing ideas for radical innovation, relying on the creativeness of employees, using techniques to stimulate creativity and creating a stimulating environment</li> <li>• Transferring ideas for innovation into feasible concepts which have a high market attractively</li> </ul>
<b>Literature</b>	Ulrich, K./Eppinger, S.: Product Design and Development, 2nd. Edition, McGraw-Hill 2010

Course L0853: Product Planning Seminar	
<b>Typ</b>	Problem-based Learning
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Cornelius Herstatt
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	Seminar is integrative part of the Module Product Planning (for content see lecture) and can not be chosen independantly
<b>Literature</b>	see/siehe Vorlesung Produktplanung/Produc Planning



Module M0830: Environmental Protection and Management	
<b>Courses</b>	
<b>Title</b>	<b>Typ</b> <b>Hrs/wk</b> <b>CP</b>
Integrated Pollution Control (L0502)	Lecture 2 2
Health, Safety and Environmental Management (L0387)	Lecture 2 3
Health, Safety and Environmental Management (L0388)	Recitation Section (small) 1 1
<b>Module Responsible</b>	NN
<b>Admission Requirements</b>	none
<b>Recommended Previous Knowledge</b>	<ul style="list-style-type: none"> <li>• Environmental Technologies</li> <li>• Environmental Legislation</li> <li>• Environmental Assessment</li> </ul>
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results
<b>Professional Competence</b>	
<i>Knowledge</i>	The students are able to describe the basics of regulations, economic instruments, voluntary initiatives, fundamentals of HSE legislation ISO 14001, EMAS and Responsible Care ISO 14001 requirements. They can analyse and discuss industrial processes, substance cycles and approaches from end-of-pipe technology to eco-efficiency and eco-effectiveness, showing their sound knowledge of complex industry related problems. They are able to judge environmental issues and to widely consider, apply or carry out innovative technical solutions, remediation measures and further interventions as well as conceptual problem solving approaches in the full range of problems in different industrial sectors.
<i>Skills</i>	Students are able to assess current problems and situations in the field of environmental protection. They can consider the best available techniques and to plan and suggest concrete actions in a company- or branch-specific context. By this means they can solve problems on a technical, administrative and legislative level.
<b>Personal Competence</b>	
<i>Social Competence</i>	The students can work together in international groups.
<i>Autonomy</i>	Students are able to organize their work flow to prepare themselves for presentations and contributions to the discussions. They can acquire appropriate knowledge by making enquiries independently.
<b>Workload in Hours</b>	Independent Study Time 110, Study Time in Lecture 70
<b>Credit points</b>	6
<b>Examination</b>	Written exam
<b>Examination duration and scale</b>	90 min
<b>Assignment for the Following Curricula</b>	Energy and Environmental Engineering: Specialisation Environmental Engineering: Elective Compulsory Environmental Engineering: Core qualification: Compulsory International Production Management: Specialisation Management: Elective Compulsory Joint European Master in Environmental Studies - Cities and Sustainability: Specialisation Water: Elective Compulsory Joint European Master in Environmental Studies - Cities and Sustainability: Specialisation Energy: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Water and Environmental Engineering: Specialisation Environment: Compulsory Water and Environmental Engineering: Specialisation Cities: Compulsory

Course L0502: Integrated Pollution Control	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Stephan Köster
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	<p>The lecture focusses on:</p> <ul style="list-style-type: none"> <li>• The Regulatory Framework</li> <li>• Pollution &amp; Impacts, Characteristics of Pollutants</li> <li>• Approaches of Integrated Pollution Control</li> <li>• Sevilla Process, Best Available Technologies &amp; BREF Documents</li> <li>• Case Studies: paper industry, cement industry, automotive industry</li> <li>• Field Trip</li> </ul>
<b>Literature</b>	

Course L0387: Health, Safety and Environmental Management	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Hans-Joachim Nau
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	<p>Objectives of and benefit from HSE management From dilution and end-of-pipe technology to eco-efficiency and eco-effectiveness Behaviour control: regulations, economic instruments and voluntary initiatives Fundamentals of HSE legislation ISO 14001, EMAS and Responsible Care ISO 14001 requirements Environmental performance evaluation Risk management: hazard, risk and safety Health and safety at the workplace Crisis management</p>
<b>Literature</b>	C. Stephan: Industrial Health, Safety and Environmental Management, MV-Verlag, Münster, 2007/2012 (can be found in the library under GTG 315)

Course L0388: Health, Safety and Environmental Management	
<b>Typ</b>	Recitation Section (small)
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Hans-Joachim Nau
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

Module M1192: Selected Topics of Business Administration (IPM)				
Courses				
Title		Typ	Hrs/wk	CP
Corporate Finance (L0866)		Lecture	2	2
Project Management Methods (L0710)		Lecture	1	2
Human Resource Management and Organization Design (IPM) (L1621)		Lecture	2	2
<b>Module Responsible</b>	Prof. Christian Ringle			
<b>Admission Requirements</b>	NITHH students are not allowed to participate in this course since Finance and Investment is an element of their management studies curriculum at NITHH.			
<b>Recommended Previous Knowledge</b>	Basic Knowledge of Principles and Concepts in Business Administration			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results			
<b>Professional Competence</b>				
<i>Knowledge</i>	<b>The students will be able to</b> <ul style="list-style-type: none"> <li>• describe complex and interrelated constructs in the fields of management of organizations, strategic and human resource management, project management and corporate finance</li> <li>• analyze the substantial aspects of organizations and organizational theories</li> <li>• describe the fields of personnel planning, acquisition and personnel development</li> <li>• name characteristics and critical success factors of projects</li> <li>• discuss typical phases in projects, corresponding tasks and challenges</li> <li>• explain and derive fiscal and financial figures</li> <li>• describe the role of finance within an international organization</li> <li>• discuss theories and models in the field of finance and investment</li> </ul>			
<i>Skills</i>	<b>The students will be able to</b> <ul style="list-style-type: none"> <li>• apply theoretical approaches and models of human resource management, organizational design, project management and corporate finance</li> <li>• discuss practical problems based on theoretical knowledge with case studies</li> <li>• analyze case studies and new practical developments</li> <li>• apply project management techniques to complex business cases</li> <li>• systematically implement project management techniques to international projects</li> <li>• evaluate theories and models of corporate finance</li> <li>• critically analyze the capital structure of an organization</li> </ul>			
<b>Personal Competence</b>				
<i>Social Competence</i>	<b>The students will be able to</b> <ul style="list-style-type: none"> <li>• have fruitful professional discussions;</li> <li>• present their results in written form and by oral presentations</li> </ul>			
<i>Autonomy</i>	<b>The students will be able to</b> <ul style="list-style-type: none"> <li>• acquire knowledge in a specific context independently and to map this knowledge onto other new complex problem fields.</li> <li>• improve their overall management skills (starting with a structured analysis of the business problem, via developing suitable solutions, to appropriately communicating/presenting solutions developed).</li> </ul>			
<b>Workload in Hours</b>	Independent Study Time 110, Study Time in Lecture 70			
<b>Credit points</b>	6			
<b>Examination</b>	Written exam			
<b>Examination duration and scale</b>	180 minutes			
<b>Assignment for the Following Curricula</b>	International Production Management: Specialisation Management: Elective Compulsory			

Course L0866: Corporate Finance	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Christian Ringle
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• Introduction to corporate finance and financial management of the multinational firm</li> <li>• Valuation and capital budgeting (e.g., time value of money, valuing stocks and corporate bonds, discounted cash flow, net present value and other criteria, making capital investment decisions)</li> <li>• Risk and return (e.g., measuring risk, risk and diversification, the cost of capital, dividend decisions, valuation principles such as WACC, APV, multiples and real options)</li> <li>• Capital structure (e.g., equity financing and stocks, debt financing and corporate bonds, leasing and off-balance-sheet financing)</li> <li>• Options and futures (e.g., call and put options, warrants and convertibles, financial risk management with derivatives)</li> <li>• Financing and financial planning of the multinational firm (e.g., financial statement analysis, short and long-term financial planning, cash and credit management)</li> <li>• International corporate finance (e.g., foreign exchange exposure and management, international portfolio investments, international mergers and acquisitions)</li> </ul>
<b>Literature</b>	<p>Brealey, R.A./Myers, S.C./Marcus, A.J. (2009): Fundamentals of Corporate Finance, 6e, Boston: McGraw-Hill.</p> <p>Brealey, R.A./Myers, S.C./Allen, F. (2011): Principles of Corporate Finance, 10e, New York: McGraw-Hill.</p> <p>Berk, J./DeMarzo, P. (2011): Corporate Finance, 2e, Boston: Pearson.</p> <p>Eun, C.S./Resnick, B.G. (2012): International Financial Management, 6e, New York: McGraw-Hill.</p> <p>Robin, J.A. (2010): International Corporate Finance, New York: McGraw-Hill.</p> <p>Ross, S.A./Westerfield, R.W./Jaffe, J. (2009): Corporate Finance, 9e, New York: McGraw-Hill.</p> <p>Ross, S.A./Westerfield, R.W./Jaffe, J. (2010): Corporate Finance: Core Principles and Applications, 3e, New York: McGraw-Hill.</p>

Course L0710: Project Management Methods	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	1
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 46, Study Time in Lecture 14
<b>Lecturer</b>	Prof. Carlos Jahn
<b>Language</b>	EN
<b>Cycle</b>	SoSe
<b>Content</b>	The course gives the participants an overview about project management as a crossover discipline. It focuses on tasks, techniques and tools which enable effective and efficient planning, implementation and controlling of projects.
<b>Literature</b>	<p>Project Management Institute (2008): A guide to the project management body of knowledge (PMBOK® Guide). 4. Aufl. Newtown Square, Pa: Project Management Institute.</p> <p>Haberfellner, R. et al. (2002): Systems Engineering - Methodik und Praxis. 11. Aufl. Verlag Industrielle Organisation.</p>

Course L1621: Human Resource Management and Organization Design (IPM)	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Christian Ringle
<b>Language</b>	EN
<b>Cycle</b>	SoSe
<b>Content</b>	<p>Advanced topics of</p> <ul style="list-style-type: none"> <li>• The Study of Organizations and Organizational Theories</li> <li>• The processes of developing organizational structures for multinational firms</li> <li>• Analysis and Design of Work</li> <li>• Strategic Management of the Human Resource Function in international business</li> <li>• Human Resource Planning and Recruitment in the global environment</li> <li>• Managing performance measurement, compensation and benefits of international corporations</li> <li>• Employee Development</li> <li>• Employee Separation and Retention</li> </ul>
<b>Literature</b>	<p>Dessler, G.: Human Resource Management, 12/e, Boston: Pearson, 2010.</p> <p>Gibson, J.L./ Ivancevich, J.M./ Donnelly, J.H./ Konopaske, R.: Organizations: Behavior, Structure, Processes, 13/e, Boston: McGraw-Hill, 2009.</p> <p>Jones, G. R.: Organizational Theory, Design, and Change, 7/e, Boston: Pearson, 2013.</p> <p>Mondy, R. W.: Human Resource Management, 12/e, Boston: Pearson, 2012.</p> <p>Noe, R.A./ Hollenbeck, J.R./ Gerhart, B./ Wright, P.M.: Human Resource Management: Gaining a Competitive Advantage, 7/e, New York: McGraw-Hill, 2010.</p>

Module M1262: Selected Topics of International Management	
<b>Courses</b>	
<b>Title</b>	<b>Typ</b> <b>Hrs/wk</b> <b>CP</b>
Advanced Research Seminar (L0936)	Seminar 2 2
Innovation Debates (L1711)	Problem-based Learning 2 2
Accounting (L1712)	Lecture 2 2
Accounting (L1713)	Recitation Section (large) 2 2
<b>Module Responsible</b>	Prof. Dieter Krause
<b>Admission Requirements</b>	none
<b>Recommended Previous Knowledge</b>	see lecture description
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results
<b>Professional Competence</b>	<ul style="list-style-type: none"> <li>Students are able to express their extended knowledge and discuss the connection of different special fields or application areas of business management</li> <li>Students are qualified to connect different special fields with each other</li> </ul>
<i>Knowledge</i>	
<i>Skills</i>	
<b>Personal Competence</b>	<ul style="list-style-type: none"> <li>Students can apply specialized solution strategies and new scientific methods in selected areas</li> <li>Students are able to transfer learned skills to new and unknown problems and can develop own solution approaches</li> </ul>
<i>Social Competence</i>	
<i>Autonomy</i>	
	Students are able to develop their knowledge and skills by autonomous election of courses.
<b>Workload in Hours</b>	Depends on choice of courses
<b>Credit points</b>	6
<b>Assignment for the Following Curricula</b>	International Production Management: Specialisation Management: Elective Compulsory

Course L0936: Advanced Research Seminar	
<b>Typ</b>	Seminar
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Examination Form</b>	Hausarbeit
<b>Examination duration and scale</b>	10-15 Seiten
<b>Lecturer</b>	Prof. Cornelius Herstatt
<b>Language</b>	EN
<b>Cycle</b>	SoSe
<b>Content</b>	In this course students will be taught to understand the research process and to interpret scientific papers as a preparation to starting their own scientific initiatives (e.g. Master-Thesis work). Students will work in groups and individually. Each group is expected to work out a presentation summarizing aspects of the research process (including practical examples) and to present and discuss it in class. Further, students will work out a written seminar paper.
<b>Literature</b>	Sekaran and Bougie (2010); Research methods for business: a skill-building approach; Wiley, Chichester Booth, Wayne C. et al. (2008); The craft of research; The University Press of Chicago, Chicago & London Punch, Keith F. (2005); Introduction to social research – quantitative and qualitative approaches; Sage Publications, London Bryman and Bell (2011); Business research methods; Oxford Univ. Press, Oxford Bell, Judith (2010); Doing your research project: a guide for first-time researchers in education, health and social science; Open University Press, Maidenhead

Course L1711: Innovation Debates	
<b>Typ</b>	Problem-based Learning
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Examination Form</b>	Schriftliche Ausarbeitung
<b>Examination duration and scale</b>	3 Präsentationen der schriftlichen Ausarbeitung à 20 Minutes
<b>Lecturer</b>	Dr. Daniel Ehls
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	<p>Scientific knowledge grows continuously but also experiences certain alignments over time. For example, early cultures had the believe of a flat earth while latest research has a spherical earth model. Also in social science and business management, from time to time certain concepts that have even been the predominant paradigm are challenged by new observations and models. Consequently, certain controversies emerge and build the base for advancing theory and managerial practice. With this lecture, we put ourselves in the middle of heated debates for informed academics and practitioners of the day after tomorrow.</p> <p>The lecture targets several controversies in the domain of technology strategy and innovation management. By the classical academic method and the novel problem based learning format of a structured discussion, a given controversy is scrutinized. On selected topics, students will discuss a dispute and gain a thorough understanding. Specifically, based on a brief introduction of a motion, a affirmative constructive as well as a negative constructive is presented by two different student groups. Each presentation is followed by a response of the other group and questions from the class. Topics range from latest theories and concepts for value capture, to the importance of operating within a global marketplace, to cutting edge approaches for innovation stimulation and technology management. Consequently, this lecture deepens the knowledge in technology strategy and innovation management (TIM), enables a critical thinking and thought leadership.</p>
<b>Literature</b>	<ol style="list-style-type: none"> <li>1. Course notes and materials provided before the lecture</li> <li>2. Leiblein/ Ziedonis (2011): Technology Strategy and innovation management. Edward Elgar Publishing Ltd (optional)</li> </ol>

Course L1712: Accounting	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Examination Form</b>	Klausur
<b>Examination duration and scale</b>	
<b>Lecturer</b>	Dr. Uwe Kagelmann
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	<p><b>Course objective:</b></p> <p>To provide a theoretical and a practical insight into the area of financial and management accounting.</p> <p><b>Approach:</b></p> <p>Illustration of theoretical concepts combined with case studies and business examples.</p> <p>The exercise is based on the development of a financial business plan for your own business idea. This financial business plan is developed in a team of 3-5 students and presented as well as discussed in the class.</p> <ol style="list-style-type: none"> <li>I. Introduction to Cost Terms and Concepts</li> <li>II. Standard Costing and Variance Analysis</li> <li>III. Financial Accounting and Reporting (Financial Statement, Income Statement, Cash Flow)</li> <li>IV. Information for Decision Making</li> <li>V. Performance Management: Planning, Budgeting &amp; Forecasting</li> </ol>
<b>Literature</b>	<p><b>Literature: Business Accounting and Finance 3e</b></p> <p>ISBN-13: 9781408018378 / ISBN-10: 1408018373; Catherine Gowthorpe, Oxford Brookes University, 576pp, Published by Cengage Learning, ©2011</p>

Course L1713: Accounting	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Examination Form</b>	Hausarbeit
<b>Examination duration and scale</b>	10-20 Seiten
<b>Lecturer</b>	Dr. Uwe Kagelmann
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course



Module M0750: Economics	
<b>Courses</b>	
<b>Title</b>	<b>Typ</b> <b>Hrs/wk</b> <b>CP</b>
International Economics (L0700)	Lecture 2 4
Main Theoretical and Political Concepts (L0641)	Lecture 2 2
<b>Module Responsible</b>	Prof. Kathrin Fischer
<b>Admission Requirements</b>	None
<b>Recommended Previous Knowledge</b>	
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results
<b>Professional Competence</b>	
<i>Knowledge</i>	The students know • the most important principles of individual decision making in a national and international context • different market structures • types of market failure • the functioning of a single economy (including money market, financial and goods markets, labor market) • the difference between and the interdependence of short and long run equilibria • the significance of expectations on the effects of economic policy • the various links between economies • different economic policies (trade, monetary, fiscal and exchange rate policy) and their effects on the home and foreign economies
<i>Skills</i>	The students are able to model analytically or graphically <ul style="list-style-type: none"> <li>• the most important principles of individual decision making in a national and international context</li> <li>• the market results of different market structures and market failure</li> <li>• the welfare effects of the market results</li> <li>• expectations hypothesis</li> <li>• the functioning of an economy (including money market, financial and goods markets, labor market)</li> <li>• links between economies</li> <li>• the effects of economic policies (trade, monetary, fiscal and exchange rate policies)</li> </ul>
<b>Personal Competence</b>	
<i>Social Competence</i>	The students are able <ul style="list-style-type: none"> <li>• to anticipate expectations and decisions of individuals or groups of individuals. These may be inside or outside of the own firm.</li> <li>• to take these decisions into account while deciding themselves</li> <li>• to understand the behavior of markets and to assess the opportunities and risks with respect to the own business activities.</li> </ul>
<i>Autonomy</i>	With the methods taught the students will be able <ul style="list-style-type: none"> <li>• to analyze empirical phenomena in single economies and the world economy and to reconcile them with the studied theoretical concepts.</li> <li>• to design, analyze and evaluate micro- and macroeconomic policies against the background of different models.</li> </ul>
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56
<b>Credit points</b>	6
<b>Examination</b>	Written exam
<b>Examination duration and scale</b>	2 hours
<b>Assignment for the Following Curricula</b>	International Production Management: Specialisation Management: Elective Compulsory International Management and Engineering: Core qualification: Compulsory Logistics, Infrastructure and Mobility: Core qualification: Elective Compulsory

Course L0700: International Economics	
Typ	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Dr. André Wolf
Language	EN
Cycle	SoSe
Content	<ul style="list-style-type: none"> <li>• International Trade Theory and Policy:               <ul style="list-style-type: none"> <li>◦ Comparative Advantage, the Ricardian Model</li> <li>◦ The Heckscher-Ohlin Model</li> <li>◦ The Standard Trade Model</li> <li>◦ Intra-sectoral Trade</li> <li>◦ International Trade Policy</li> </ul> </li> <li>• Open Economy Macroeconomics               <ul style="list-style-type: none"> <li>◦ The Foreign Exchange Market</li> <li>◦ Determinants of Prices, Interest Rates, Exchange Rates, Output in the Short Run</li> <li>◦ Determinants of Prices, Interest Rates, Exchange Rates, Output in the Long Run</li> <li>◦ Monetary and Fiscal and Exchange Rate Policies in Open Economies in the Long and the Short Run</li> </ul> </li> </ul>
Literature	Krugman/Obstfeld: International Economics, Longman, 9th ed. 2011  Mankiw/Taylor: Economics, South-Western 2008  Skripte und Textdokumente, die während der Vorlesung herausgegeben werden.

Course L0641: Main Theoretical and Political Concepts	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Michael Bräuninger
Language	EN
Cycle	SoSe
Content	<ul style="list-style-type: none"> <li>• <b>Introduction: Ten Principles of Economics</b></li> <li>• Microeconomics:               <ul style="list-style-type: none"> <li>◦ Theory of the Household</li> <li>◦ Theory of the Firm</li> <li>◦ Competitive Markets in Equilibrium</li> <li>◦ Market Failure: Monopoly and External Effects</li> <li>◦ Government Policies</li> </ul> </li> <li>• Macroeconomics:               <ul style="list-style-type: none"> <li>◦ A Nation's Real Income and Production</li> <li>◦ The Real Economy in the Long Run: Capital and Labour Market</li> <li>◦ Money and Prices in the Long Run</li> <li>◦ Aggregate Demand and Supply: Short-Run Economic Fluctuations</li> <li>◦ Monetary and Fiscal Policy in the Short and the Long Run</li> </ul> </li> </ul>
Literature	Mankiw/Taylor: Economics, South-Western 2008  Pindyck/Rubinfeld: Microeconomics, Prentice Hall International, 7 <sup>th</sup> ed. 2010  Skripte und Textdokumente, die während der Vorlesung herausgegeben werden.

Module M0855: Module Marketing (Sales and Services / Innovation Marketing)			
Courses			
Title	Typ	Hrs/wk	CP
Module Marketing (Innovation Marketing / Sales and Services) (L0862)	Problem-based Learning	5	6
<b>Module Responsible</b>	Prof. Christian Lütjhe		
<b>Admission Requirements</b>	None		
<b>Recommended Previous Knowledge</b>	<ul style="list-style-type: none"> <li>• Basic understanding of business administration principles (strategic planning, decision theory, project management, international business)</li> <li>• Bachelor-level Marketing Knowledge (Marketing Instruments, Market and Competitor Strategies, Basics of Buying Behavior)</li> <li>• Understanding of differences in the market introduction of Products and Services</li> <li>• Understanding the differences between B2B and B2C marketing</li> <li>• Understanding of the importance of managing innovation in global industrial markets</li> <li>• Good English proficiency; presentation skills</li> </ul>		
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results		
<b>Professional Competence</b>			
<i>Knowledge</i>	<p><b>Knowledge</b></p> <p>Students will have gained a deep understanding of</p> <ul style="list-style-type: none"> <li>• Specific characteristics in the marketing of innovative industrial goods and services</li> <li>• The importance of product-related and independent services</li> <li>• Approaches for analyzing the current market situation and the future market development</li> <li>• The gathering of information about future customer needs and requirements</li> <li>• Concepts and approaches to integrate lead users and their needs into product and service development processes</li> <li>• Approaches and tools for ensuring customer-orientation in the development of new products and innovative services</li> <li>• Marketing mix elements that take into consideration the specific requirements and challenges of innovative products and services</li> <li>• Pricing methods for new products and services</li> <li>• The organization of complex sales forces and personal selling</li> <li>• Communication concepts and instruments for new products and services</li> </ul>		
<i>Skills</i>	<p><b>Skills</b></p> <p>Based on the acquired knowledge students will be able to:</p> <ul style="list-style-type: none"> <li>• Design and to evaluate decisions regarding marketing and innovation strategies</li> <li>• Analyze markets by applying market and technology portfolios</li> <li>• Conduct forecasts and develop compelling scenarios as a basis for strategic planning</li> <li>• Translate customer needs into concepts, prototypes and marketable offers and successfully apply advanced methods for customer-oriented product and service development</li> <li>• Use adequate methods to foster efficient diffusion of innovative products and services</li> <li>• Choose suitable pricing strategies and communication activities for innovations</li> <li>• Make strategic sales decisions for products and services (i.e. selection of sales channels)</li> <li>• Apply methods of sales force management (i.e. customer value analysis)</li> </ul>		
<b>Personal Competence</b>			
<i>Social Competence</i>	<p><b>Social Competence</b></p> <p>The students will be able to</p> <ul style="list-style-type: none"> <li>• have fruitful discussions and exchange arguments</li> <li>• develop original results in a group</li> <li>• present results in a clear and concise way</li> <li>• carry out respectful team work</li> </ul>		
<i>Autonomy</i>	<p><b>Self-reliance</b></p> <p>The students will be able to</p> <ul style="list-style-type: none"> <li>• Acquire knowledge independently in the specific context and to map this knowledge on other new complex problem fields.</li> <li>• Consider proposed business actions in the field of marketing and reflect on them.</li> </ul>		

<b>Workload in Hours</b>	Independent Study Time 110, Study Time in Lecture 70
<b>Credit points</b>	6
<b>Examination</b>	Written exam
<b>Examination duration and scale</b>	90 min
<b>Assignment for the Following Curricula</b>	International Production Management: Specialisation Management: Elective Compulsory International Management and Engineering: Specialisation I. Electives Management: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprotheses: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Compulsory

Course L0862: Module Marketing (Innovation Marketing / Sales and Services)	
<b>Typ</b>	Problem-based Learning
<b>Hrs/wk</b>	5
<b>CP</b>	6
<b>Workload in Hours</b>	Independent Study Time 110, Study Time in Lecture 70
<b>Lecturer</b>	Prof. Christian Lütjhe
<b>Language</b>	EN
<b>Cycle</b>	SoSe
<b>Content</b>	<p>I. Introduction</p> <ul style="list-style-type: none"> <li>Strategic marketing (importance of innovative products and services, model, objectives and examples of innovation marketing)</li> </ul> <p>II. Methods and approaches of strategic marketing planning</p> <ul style="list-style-type: none"> <li>patterns of industrial development, patent and technology portfolios</li> </ul> <p>III. Strategic foresight and scenario analysis</p> <ul style="list-style-type: none"> <li>objectives and challenges of strategic foresight, scenario analysis, Delphi method</li> </ul> <p>IV. Mapping Techniques</p> <ul style="list-style-type: none"> <li>Perceptual Maps, Gap Model</li> </ul> <p>V. User innovations</p> <ul style="list-style-type: none"> <li>User innovation (role of users in the innovation process, user communities, user innovation toolkits, lead users analysis)</li> </ul> <p>VI. Product and Service Engineering</p> <ul style="list-style-type: none"> <li>Concept Development (Conjoint, Kano, QFD, Morphological Analysis, Blueprinting)</li> </ul> <p>VII. Pricing</p> <ul style="list-style-type: none"> <li>Basics of Pricing, Price Window, Pricing of new Products</li> </ul> <p>VIII. Sales Management</p> <ul style="list-style-type: none"> <li>Basics of Sales Management, Assessing Customer Value, Planning Customer Visits</li> </ul> <p>XI. Communications</p> <ul style="list-style-type: none"> <li>Diffusion of Innovations, Communication Objectives, Communication Grid</li> </ul>
<b>Literature</b>	<p>Kotler, P., Keller, K. L. (2006). Marketing Management, 12 th edition, Pearson Prentice Hall, New Jersey</p> <p>Bo Edvardsson et. al. (2006) Involving Customers in New Service Development, London</p> <p>Joe Tidd &amp; Frank M. Hull (Editors) (2007) Service Innovation, London</p> <p>Von Hippel, E.(2005). Democratizing Innovation, Cambridge: MIT Press</p> <p>Crawford, M., Di Benedetto, A. (2008). New products management, 9th edition, McGrw Hill, Boston et al., 2008</p>

Module M1034: Technology Entrepreneurship				
<b>Courses</b>				
<b>Title</b>		<b>Typ</b>	<b>Hrs/wk</b>	<b>CP</b>
Creation of Business Opportunities (L1280)		Problem-based Learning	3	4
Entrepreneurship (L1279)		Lecture	2	2
<b>Module Responsible</b>	Prof. Christoph Ihl			
<b>Admission Requirements</b>	None			
<b>Recommended Previous Knowledge</b>	Basic knowledge in business economics obtained in the compulsory modules as well as an interest in new technologies and the pursuit of new business opportunities either in corporate or startup contexts.			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results			
<b>Professional Competence</b>				
<i>Knowledge</i>	Wissen (subject-related knowledge and understanding):			
	<ul style="list-style-type: none"> <li>• develop a working knowledge and understanding of the entrepreneurial perspective</li> <li>• understand the difference between a good idea and scalable business opportunity</li> <li>• understand the process of taking a technology idea and finding a high-potential commercial opportunity</li> <li>• understand the components of business models</li> <li>• understand the components of business opportunity assessment and business plans</li> </ul>			
<i>Skills</i>	<ul style="list-style-type: none"> <li>• Fertigkeiten (subject-related skills):               <ul style="list-style-type: none"> <li>◦ identify and define business opportunities</li> <li>◦ assess and validate entrepreneurial opportunities</li> <li>◦ create and verify a business model of how to sell and market an entrepreneurial opportunity</li> <li>◦ formulate and test business model assumptions and hypotheses</li> <li>◦ conduct customer and expert interviews regarding business opportunities</li> <li>◦ prepare business opportunity assessment</li> <li>◦ create and verify a plan for gathering resources such as talent and capital</li> <li>◦ pitch a business opportunity to your classmates and the teaching team</li> </ul> </li> </ul>			
<b>Personal Competence</b>				
<i>Social Competence</i>	Sozialkompetenz (Social Competence):			
	<ul style="list-style-type: none"> <li>• team work</li> <li>• communication and presentation</li> <li>• give and take critical comments</li> <li>• engaging in fruitful discussions</li> </ul>			
<i>Autonomy</i>	Selbständigkeit (Autonomy):			
	<ul style="list-style-type: none"> <li>• autonomous work and time management</li> <li>• project management</li> <li>• analytical skills</li> </ul>			
<b>Workload in Hours</b>	Independent Study Time 110, Study Time in Lecture 70			
<b>Credit points</b>	6			
<b>Examination</b>	Written elaboration			
<b>Examination duration and scale</b>				
<b>Assignment for the Following Curricula</b>	International Production Management: Specialisation Management: Elective Compulsory International Management and Engineering: Specialisation I. Electives Management: Elective Compulsory Logistics, Infrastructure and Mobility: Core qualification: Elective Compulsory			

Course L1280: Creation of Business Opportunities	
<b>Typ</b>	Problem-based Learning
<b>Hrs/wk</b>	3
<b>CP</b>	4
<b>Workload in Hours</b>	Independent Study Time 78, Study Time in Lecture 42
<b>Lecturer</b>	Prof. Christoph Ihl
<b>Language</b>	EN
<b>Cycle</b>	SoSe
<b>Content</b>	<p>This course is supposed to provide intense hands-on experiences with the entrepreneurial process, tools and concepts discussed in the lecture "Entrepreneurship" and additional online material. At the beginning of the class, students form teams to search for and create a scalable and repeatable business opportunity. Rather than writing a comprehensive business plan or designing the perfect product, both of which are highly difficult and risky investments in the uncertain front end of any business idea, we follow a lean startup approach. Student teams will have to think about all the parts of building a business and apply the tools of business model design and customer &amp; agile development in order to optimize the search for and creation of a business opportunity. Students will start by mapping the assumptions regarding each of the parts in their business model and then devote significant time on testing these hypotheses with customers and partners outside in the field (customer development). Based on the gathered information, students should realize which of their assumptions were wrong, and figure out ways how to fix it (learning events called "pivots"). The goal is to proceed in an iterative and incremental way (agile development) to build prototypes and (minimum viable) products. Throughout the course, student teams will present their lessons-learned (pivots) and how their business models have evolved based on their most important pivots.</p>
<b>Literature</b>	<p>Blank, Steve (2013). Why the lean start-up changes everything. Harvard Business Review 91.5 (2013): 63-72.</p> <p>Blank, Steven Gary, and Bob Dorf. The startup owner's manual: the step-by-step guide for building a great company. K&amp;S Ranch, Incorporated, 2012.</p> <p>Ries, Eric (2011). The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses. Random House LLC, 2011.</p>

Course L1279: Entrepreneurship	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Christoph Ihl
<b>Language</b>	EN
<b>Cycle</b>	SoSe
<b>Content</b>	<p>This course introduces the fundamentals of technology entrepreneurship including its economic and cultural underpinnings. It highlights the differences between mere business ideas and scalable and repeatable business opportunities. It is designed to familiarize students with the process that technology entrepreneurs use to create business opportunities and to start companies. It involves taking a technology idea and finding a high-potential commercial opportunity, gathering resources such as talent and capital, figuring out how to sell and market the idea, and managing rapid growth. The course also discusses relevant concepts and tools from entrepreneurial strategy, such as disruptive innovations, technology adoption cycles and intellectual property, as well as from entrepreneurial marketing, such as product positioning and differentiation, distribution, promotion and pricing. Particular emphasis will be put on business model design and customer development proposed in the lean startup approach. All in all, the course is supposed to create the entrepreneurial mindset of looking for technology opportunities and business solutions, where others see insurmountable problems. This mindset of turning problems into opportunities can well be generalized from startups to larger companies and other settings.</p>
<b>Literature</b>	<p>Byers, T.H.; Dorf, R.C.; Nelson, A.J. (2011). Technology Ventures: From Idea to Enterprise. 3rd ed. McGraw-Hill, 2011.</p> <p>Hisrich, P.; Peters, M. P.; Shepherd, D. A. (2009). Entrepreneurship, 8th ed., McGraw-Hill, 2009.</p> <p>Osterwalder, A.; Yves, P. (2010). Business model generation: a handbook for visionaries, game changers, and challengers. John Wiley &amp; Sons, 2010.</p>

Module M0978: Internationale Logistics and Transport Systems				
<b>Courses</b>				
<b>Title</b>		<b>Typ</b>	<b>Hrs/wk</b>	<b>CP</b>
Mobility of Goods, Logistics, Traffic (L1165)		Lecture	2	2
International Logistics and Transport Systems (L1168)		Problem-based Learning	3	4
<b>Module Responsible</b>	Prof. Heike Flämig			
<b>Admission Requirements</b>	none			
<b>Recommended Previous Knowledge</b>	<ul style="list-style-type: none"> <li>• Introduction to Logistics and Mobility</li> <li>• Foundations of Management</li> <li>• Legal Foundations of Transportation and Logistics</li> </ul>			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results			
<b>Professional Competence</b>				
<i>Knowledge</i>	Students are able to... <ul style="list-style-type: none"> <li>• give definitions of system theory, (international) transport chains and logistics in the context of supply chain management</li> <li>• explain trends and strategies for mobility of goods and logistics</li> <li>• describe elements of integrated and multi-modal transport chains and their advantages and disadvantages</li> <li>• deduce impacts of management decisions on logistics system and traffic system and explain how stakeholders influence them</li> <li>• explain the correlations between economy and logistics systems, mobility of goods, space-time-structures and the traffic system as well as ecology and politics</li> </ul>			
<i>Skills</i>	Students are able to... <ul style="list-style-type: none"> <li>• Design intermodal transport chains and logistic concepts</li> <li>• apply the commodity chain theory and case study analysis</li> <li>• evaluate different international transport chains</li> <li>• cope with differences in cultures that influence international transport chains</li> </ul>			
<b>Personal Competence</b>				
<i>Social Competence</i>	Students are able to... <ul style="list-style-type: none"> <li>• develop a feeling of social responsibility for their future jobs</li> <li>• give constructive feedback to others about their presentation skills</li> <li>• plan and execute teamwork tasks</li> </ul>			
<i>Autonomy</i>	Students are able to improve presentation skills by feedback of others			
<b>Workload in Hours</b>	Independent Study Time 110, Study Time in Lecture 70			
<b>Credit points</b>	6			
<b>Examination</b>	Written exam			
<b>Examination duration and scale</b>	60 minutes			
<b>Assignment for the Following Curricula</b>	International Production Management: Specialisation Management: Elective Compulsory International Management and Engineering: Specialisation II. Logistics: Elective Compulsory Joint European Master in Environmental Studies - Cities and Sustainability: Core qualification: Compulsory Logistics, Infrastructure and Mobility: Specialisation Production and Logistics: Elective Compulsory Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective Compulsory			

Course L1165: Mobility of Goods, Logistics, Traffic	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Heike Flämig
<b>Language</b>	EN
<b>Cycle</b>	SoSe
<b>Content</b>	<p>The intention of this lecture is to provide a general system analysis-based overview of how transportation chains emerge and how they are developed. The respective advantages and disadvantages of different international transportation chains of goods are to be pointed out from a micro- and a macroeconomic point of view. The effects on the traffic system as well as the ecological and social consequences of a spatial division of economical activities are to be discussed.</p> <p>The overview of current international transportation chains is carried out on the basis of concrete material- and appendant information flows. Established transportation chains and some of their individual elements are to become transparent to the students by a number of practical examples.</p> <ol style="list-style-type: none"> <li>1. A conceptual systems model</li> <li>2. Elements of integrated and multi-modal transportation chains</li> <li>3. interaction of transport and traffic, demand and supply on different layers of the transport system</li> <li>4. Global Issues in Supply Chain Management</li> <li>5. Global Players and networks</li> <li>6. Logistics and corporate social responsibility (CSR)</li> <li>7. Methods and data for assessment of international transport chains</li> <li>8. Influence of cultural aspects on international transport chains</li> <li>9. New solutions using different focuses of the transport and logistics system</li> </ol>
<b>Literature</b>	<p>David, Pierre A.; Stewart, Richard D.: International Logistics: The Management of International Trade Operations, 3rd Edition, Mason, 2010</p> <p>Schieck, Arno: Internationale Logistik: Objekte, Prozesse und Infrastrukturen grenzüberschreitender Güterströme, München, 2009</p> <p>BLOECH, J., IHDE, G. B. (1997) Vahlens Großes Logistikleikon, München, Verlag C.H. Beck</p> <p>IHDE, G. B. (1991) Transport, Verkehr, Logistik, München, Verlag Franz Vahlen, 2. völlig überarbeitete und erweiterte Auflage</p> <p>NUHN, H., HESSE, M. (2006) Verkehrsgeographie, Paderborn, München, Wien, Zürich, Verlage Ferdinand Schöningh</p> <p>PFOHL, H.-C. (2000) Logistiksysteme - Betriebswirtschaftliche Grundlagen, Berlin, Heidelberg, New York, Springer-Verlag, 6. Auflage</p>

Course L1168: International Logistics and Transport Systems	
<b>Typ</b>	Problem-based Learning
<b>Hrs/wk</b>	3
<b>CP</b>	4
<b>Workload in Hours</b>	Independent Study Time 78, Study Time in Lecture 42
<b>Lecturer</b>	Prof. Heike Flämig
<b>Language</b>	EN
<b>Cycle</b>	SoSe
<b>Content</b>	<p>The problem-oriented-learning lecture consists of case studies and complex problems concerning the systemic characteristics of different modes of transport as well as the organization and realization of transport chains. Students get to know specific issues from practice of logistics and mobility of goods and work out recommendations for solutions.</p>
<b>Literature</b>	<p>David, Pierre A.; Stewart, Richard D.: International Logistics: The Management of International Trade Operations, 3rd Edition, Mason, 2010</p> <p>Schieck, Arno: Internationale Logistik: Objekte, Prozesse und Infrastrukturen grenzüberschreitender Güterströme, München, 2009</p>



Module M1255: International Production Management and Enterprise Resource Planning: CERMEDES AG				
Courses				
Title	Typ	Hrs/wk	CP	
International Production Management and Enterprise Resource Planning: CERMEDES AG (L1232)	Seminar	2	6	
<b>Module Responsible</b>	Prof. Christian Ringle			
<b>Admission Requirements</b>	None, but limited number of students: 25			
<b>Recommended Previous Knowledge</b>	Basic knowledge in business administration			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results			
<b>Professional Competence</b>				
<i>Knowledge</i>	Students will be able to			
	<ul style="list-style-type: none"> <li>describe complex and interrelated business processes along the supply chain</li> <li>explain business processes and their implementation in SAP (based on a model company)</li> <li>summarize process and project management techniques of Enterprise Resource Planning-(ERP)-Software implementation</li> <li>describe the functioning and use of ERP-Software along the supply chain</li> <li>discuss the integrative role of ERP-Systems</li> </ul>			
<i>Skills</i>	The students will be able to			
	<ul style="list-style-type: none"> <li>design business processes along the supply chain of a firm</li> <li>implement the process of ERP-Software, i.e. customizing an SAP system</li> <li>use ERP-Software, i.e. operatively run an SAP system</li> <li>critically evaluate ERP-Software along the theoretical requirements for optimally designing a business process</li> </ul>			
<b>Personal Competence</b>				
<i>Social Competence</i>	The students will be able to			
	<ul style="list-style-type: none"> <li>have fruitful professional discussions;</li> <li>present and defend the results of their work;</li> <li>communicate and collaborate successfully and respectfully with others in teams.</li> </ul>			
<i>Autonomy</i>	The students will be able to			
	<ul style="list-style-type: none"> <li>acquire knowledge in a specific context independently and to map this knowledge onto other new complex problem fields.</li> </ul>			
<b>Workload in Hours</b>	Independent Study Time 152, Study Time in Lecture 28			
<b>Credit points</b>	6			
<b>Examination</b>	Written elaboration			
<b>Examination duration and scale</b>	12 pages per student; 3 months			
<b>Assignment for the Following Curricula</b>	International Production Management: Specialisation Management: Elective Compulsory			

Course L1232: International Production Management and Enterprise Resource Planning: CERMEDES AG	
<b>Typ</b>	Seminar
<b>Hrs/wk</b>	2
<b>CP</b>	6
<b>Workload in Hours</b>	Independent Study Time 152, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Christian Ringle
<b>Language</b>	EN
<b>Cycle</b>	SoSe
<b>Content</b>	<p>The course consists of three parts:</p> <p>During the first part of the course, participants are provided with insights into the market for ERP-Software and are provided with knowledge on how ERP-implementation projects proceed and how these projects should ideally be managed from a theoretical and practical perspective. Participants are introduced into the basic functioning of ERP-Software referring to the most common system (SAP). Participants gain a basic understanding of implementing organizational data, master data and processes into the system.</p> <p>The second part of the course involves working on a seminar thesis which takes place parallel to the first rather lecture-type sessions. Participants are in teams invited to design a theoretical concept for the functioning of certain business units within the firm (e.g. procurement, production, sales and distribution). Their concept should then be incorporated into both, a seminar thesis to be handed in and a first short presentation to be held in the seminar in the middle of the semester.</p> <p>During the third part of the course, participants implement their theoretical concept into the ERP-System, i.e. they customize the SAP system according to the theoretical requirements defined. In the context of this process, the participants are encouraged to critically evaluate the software options in light of a theoretically ideal design of business functions and processes. This third part of the course is designed in the form of mini-presentations by each team of participants giving an overview of the progress and critical evaluations made in implementing the theoretical concept into the system.</p> <p>Students will gain...</p> <ul style="list-style-type: none"> <li>... insights into the ERP-Market</li> <li>... insights into the process (&amp; project management) of ERP-Software implementation</li> <li>... insights into the functioning and use of ERP-Software</li> <li>... an understanding of business processes and their implementation in SAP (production)</li> <li>... an understanding of the integrative role of ERP-Systems ...the ability to operatively run SAP &amp; critically evaluate the functioning of the system!</li> </ul>
<b>Literature</b>	<ul style="list-style-type: none"> <li>• Agrawal, A. (2009): Customizing Materials Management Processes in SAP ERP Operatons, Galileo Press: Boston.</li> <li>• Arif, N./Tauseef, S. (2011): Integrating SAP ERP Financials, Galileo Press: Boston.</li> <li>• Chudy, M./Castedo, L. (2010): Sales and Distribution in SAP ERP – Practical Guide, Galileo Press: Boston.</li> <li>• Dickersback, J. T./Keller, G. (2011): Production Planning and Control with SAP ERP, Galileo Press: Boston.</li> <li>• Franz, M. (2010): Project Management with SAP Project System, Galileo Press: Boston.</li> <li>• Hoppe, M./Gulyassy, F. (2009): Materials Planning with SAP, Galileo Press: Boston.</li> <li>• Veeriah, N. (2011): Customizing Financial Accounting in SAP, Galileo Press: Boston.</li> <li>• Veeriah, N. (2012): Financial Accounting in SAP, Galileo Press: Boston.</li> </ul>

Module M1263: Quantitative Research Methods			
Courses			
Title	Typ	Hrs/wk	CP
Quantitative Research Methods (L1714)	Project Seminar	3	6
<b>Module Responsible</b>	Prof. Christian Ringle		
<b>Admission Requirements</b>	None, but the course is limited to 20 students		
<b>Recommended Previous Knowledge</b>	Basic knowledge in business administration		
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results		
<b>Professional Competence</b>			
<i>Knowledge</i>	The students will be able to <ul style="list-style-type: none"> <li>• describe complex and interrelated constructs in the fields of marketing, management of organizations, strategic and human resource management</li> <li>• discuss underlying theories of research models</li> <li>• explain strategies of research problem analysis</li> <li>• describe the functioning and use of quantitative research methods</li> <li>• discuss strengths and weaknesses of quantitative research methods</li> </ul>		
<i>Skills</i>	The students will be able to <ul style="list-style-type: none"> <li>• deal with complex empirical problems</li> <li>• collect empirical data, apply multivariate techniques to the data collected using standard software, and critically evaluate and interpret results gained</li> <li>• work with common statistical software programs (like R, Smart PLS and SPSS)</li> <li>• address research questions with quantitative research methods</li> </ul>		
<b>Personal Competence</b>			
<i>Social Competence</i>	The students will be able to <ul style="list-style-type: none"> <li>• have fruitful professional discussions;</li> <li>• present and defend the results of their work;</li> <li>• communicate and collaborate successfully and respectfully with others in teams.</li> </ul>		
<i>Autonomy</i>	The students will be able to <ul style="list-style-type: none"> <li>• acquire knowledge in a specific context independently and to map this knowledge onto other new complex problem fields.</li> <li>• read and understand statistical literature</li> </ul>		
<b>Workload in Hours</b>	Independent Study Time 138, Study Time in Lecture 42		
<b>Credit points</b>	6		
<b>Examination</b>	Project		
<b>Examination duration and scale</b>	30 pages; 5 months		
<b>Assignment for the Following Curricula</b>	International Production Management: Specialisation Management: Elective Compulsory		

Course L1714: Quantitative Research Methods	
Typ	Project Seminar
Hrs/wk	3
CP	6
Workload in Hours	Independent Study Time 138, Study Time in Lecture 42
Lecturer	Prof. Christian Ringle
Language	EN
Cycle	WiSe/SoSe
Content	<p>Participants will understand the use, requirements, advantages and disadvantages of quantitative methods. Examples illustrate the application of quantitative methods and their use to address business related problems.</p> <p>The course involves three parts:</p> <p>The first part of the course focuses on an introduction of quantitative research methods.</p> <p>The second part of the course involves working on a seminar thesis. Participants are in teams invited to describe selected quantitative research methods and to address simple research questions with the described method. Students are expected to write a short (empirical) paper that applies methods learned in this course to a research question of their choice.</p> <p>The third part is the final presentations of the results from the group work. Participants will present their own small research projects and discuss the results in the plenum. Participants are invited to join the discussions as a part of the final grade.</p>
Literature	<p>Participants will be provided with a course handout in the form of ppt-slides which can be downloaded in advance. In the course, the participants will obtain a specific list of relevant literature. Some generally recommended are:</p> <ul style="list-style-type: none"> <li>• Dalgaard, P. (2008). Introductory statistics with R. Springer Science &amp; Business Media.</li> <li>• Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., &amp; Tatham, R. L. (2006). Multivariate data analysis (Vol. 6). Upper Saddle River, NJ: Pearson Prentice Hall.</li> <li>• Hair Jr, J. F., Hult, G. T. M., Ringle, C., &amp; Sarstedt, M. (2013). A primer on partial least squares structural equation modeling (PLS-SEM). Sage Publications.</li> </ul>

Module M1035: Corporate Entrepreneurship & Growth				
Courses				
Title	Typ	Hrs/wk	CP	
Entrepreneurial Finance (L1282)	Seminar	2	2	
Intrapreneurship (L1281)	Seminar	3	4	
<b>Module Responsible</b>	Prof. Christoph Ihl			
<b>Admission Requirements</b>	Limited number of students: 20			
<b>Recommended Previous Knowledge</b>	Basic knowledge in business economics and finance obtained in the compulsory modules and participation in the module "Technology Entrepreneurship" is highly recommended.			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results			
<b>Professional Competence</b>				
<i>Knowledge</i>	Wissen (subject-related knowledge and understanding): <ul style="list-style-type: none"> <li>• understand similarities and differences between corporate and start-up entrepreneurship</li> <li>• recognize the distinct nature and specific elements of corporate entrepreneurship in the context of established and international organizations</li> <li>• understand the different forms of corporate entrepreneurship</li> <li>• understand their own managerial styles, attitudes and preferences for corporate versus start-up entrepreneurship</li> <li>• understand the pros and cons of different valuation methods</li> <li>• understand the interests of venture capital funds</li> <li>• understand the pros and cons of different growth and exit options</li> </ul>			
<i>Skills</i>	Fertigkeiten (subject-related skills): <ul style="list-style-type: none"> <li>• be able to apply an entrepreneurial approach to operations of a department or functional area within established organizations</li> <li>• assess the environment within established companies in terms of support or constraints for entrepreneurship</li> <li>• identify creative ways to overcome obstacles to entrepreneurship in established companies</li> <li>• be able to formulate corporate objectives and strategies that support entrepreneurial behavior</li> <li>• evaluate entrepreneurial opportunities in contexts of established corporations</li> <li>• develop concepts for new businesses out of established company contexts</li> <li>• value entrepreneurial opportunities in financial terms</li> <li>• apply different valuation methods</li> <li>• evaluate the attractiveness of financial contracts</li> <li>• design VC term sheets</li> <li>• design employee contracts in terms of financial compensation</li> <li>• design financial contracts and conduct financial negotiations</li> <li>• assess and justify possible growth and exit options</li> </ul>			
<b>Personal Competence</b>				
<i>Social Competence</i>	Sozialkompetenz (Social Competence): <ul style="list-style-type: none"> <li>• team work</li> <li>• communication and presentation</li> <li>• give and take critical comments</li> <li>• engaging in fruitful discussions</li> </ul>			
<i>Autonomy</i>	Selbständigkeit (Autonomy): <ul style="list-style-type: none"> <li>• autonomous work and time management</li> <li>• project management</li> <li>• analytical skills</li> </ul>			
<b>Workload in Hours</b>	Independent Study Time 110, Study Time in Lecture 70			
<b>Credit points</b>	6			
<b>Examination</b>	Project			
<b>Examination duration and scale</b>	Group project work (approx. 30 pages) and oral examination (15 min plus discussion)			
<b>Assignment for the Following Curricula</b>	Global Innovation Management: Core qualification: Elective Compulsory International Production Management: Specialisation Management: Elective Compulsory International Management and Engineering: Specialisation I. Electives Management: Elective Compulsory Mechanical Engineering and Management: Specialisation Management: Elective Compulsory			

Course L1282: Entrepreneurial Finance	
<b>Typ</b>	Seminar
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Christoph Ihl
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	<p>This course examines the elements of entrepreneurial finance, focusing on technology-based start-up ventures and the early stages of company development. The course addresses key questions relevant to both startup and corporate entrepreneurs: How much money can and should be raised? When should it be raised and from whom? What is a reasonable valuation of the company? How should funding, employment contracts and exit decisions be structured? This course will focus on the finance principles related to the risk &amp; return of venture capital, the valuation of high growth companies, the capital structure specific to venture capital-backed companies, and investment decisions under uncertainty. Three main topics will be covered:</p> <p>(1) New business opportunity valuation: Most time will be devoted to the understanding and application of tools to value early stage business opportunities and high-growth companies versus mature companies. Standard tools for financial and liquidity planning as well as discounted cash flow valuation will be applied to startup situations. Furthermore, the venture capital method, analysis of comparables and the real options approach to valuation are introduced.</p> <p>(2) Financing and employment contracts: We will discuss the main sources of financing that entrepreneurs can choose from. Particular emphasis will be put on venture capital funds and their fund raising process. The design of financial contracts will be analyzed in terms of addressing information and incentive problems in uncertain environments. Employment contracts will be motivated as a compensation device to attract and retain key employees.</p> <p>(3) Growth and exit strategies: We will discuss entrepreneurs' option to grow or exit. Liquidity events are considered such as initial public offering, sale or merger as compared to independent growth as a private company. We also examine later stage options such as mezzanine financing and buy-outs and the specifics of international growth.</p> <p>Guest lecturers will present the latest trends in these areas. The ideal audience for the course will be students who are interested in technology entrepreneurship, either at startups or within larger organizations. It is also useful for those pursuing careers in corporate finance or valuation consulting.</p>
<b>Literature</b>	<p>Metrick, Andrew, and Ayako Yasuda. Venture Capital and the Finance of Innovation. Wiley, 2010.</p> <p>Leach, J., and Ronald Melicher. Entrepreneurial finance. Cengage Learning, 2011.</p> <p>Selected cases will be made available during class.</p>

Course L1281: Intrapreneurship	
<b>Typ</b>	Seminar
<b>Hrs/wk</b>	3
<b>CP</b>	4
<b>Workload in Hours</b>	Independent Study Time 78, Study Time in Lecture 42
<b>Lecturer</b>	Prof. Christoph Ihl
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	<p>In order to sustain competitive advantage, established firms must do more than lower costs, increase quality and better serve customers. They have to be faster, more flexible, more aggressive and more innovative while operating under resource constraints. In short, they must be more entrepreneurial. While most CEOs would subscribe to this point of view, yet few companies seem to be able to fully embrace the issues of corporate entrepreneurship, the subject matter of this course. This is an overview course on corporate entrepreneurship. It is not designed to cover all of the aspects of the corporation that affect the firm's organization, strategy and performance. Rather, it is designed to introduce students to the different forms, core concepts and analytical tools in corporate entrepreneurship in order to enable the creation of viable new businesses within the context of an established organization. The course will address the development of an internal culture, strategy and structure supportive to corporate entrepreneurship, the international dimension of corporate entrepreneurship as well as the analysis of potential synergies and barriers between potential new ventures and the existing organization. To achieve these goals, the course will combine (1) class lectures on key theoretical concepts, tools, and management approaches, (2) an in-depth case analysis of a classic Harvard Business School case, and (3) a real life case brought to the class room by actual company representatives upon which student teams develop their project work.</p>
<b>Literature</b>	<p>Morris, Michael, Donald Kuratko, and Jeffrey Covin. Corporate entrepreneurship &amp; innovation. Cengage Learning, 2010.</p> <p>Christensen, Clayton M., and Ho Howard Yu. "Pitney Bowes Inc." Harvard Business School Case 607-034, November 2006.</p>

Module M0543: Management, Organization and Human Resource Management				
Courses				
Title	Typ	Hrs/wk	CP	
Management, Organization and Human Resource Management (L0110)	Lecture	2	3	
Management, Organization and Human Resource Management (L0111)	Seminar	2	3	
<b>Module Responsible</b>	Prof. Christian Ringle			
<b>Admission Requirements</b>	None Limited number of students: 20			
<b>Recommended Previous Knowledge</b>	Module "Human Resource Management and Organizational Design" Knowledge of <ul style="list-style-type: none"> <li>• The Study of Organizations and Organizational Theories</li> <li>• The processes of developing organizational structures for multinational firms</li> <li>• Analysis and Design of Work</li> <li>• Strategic Management of the Human Resource Function in international business</li> <li>• Human Resource Planning and Recruitment in the global environment</li> <li>• Managing performance measurement, compensation and benefits of international corporations</li> <li>• Employee Development</li> <li>• Employee Separation and Retention</li> </ul>			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results			
<b>Professional Competence</b>				
<i>Knowledge</i>	The students are able to ... <ul style="list-style-type: none"> <li>• explain the different organizational design and strategies in an international environment with a focus on selected forms of cooperation (e.g., virtual organizations, strategic alliances) to compete in global business;</li> <li>• map the need of organizational changes in light of new business lines, new strategies, altering employee attitudes and international competition;</li> <li>• describe the business process management and reengineering techniques in order to consolidate resources to meet international customer requirements profitably;</li> <li>• explain the meaning and importance of managing human resources in multinational companies and its relation to organizational designs and strategies;</li> <li>• explain the personnel recruitment and talent management strategies (e.g., personnel planning, employee testing, developing) throughout national and international organizations;</li> <li>• explain the models and approaches for appropriately measuring employee relations (e.g., job satisfaction models) including the development and estimation of causal models;</li> <li>• present the models and research methodologies used to forecast personnel requirements (e.g., forecasting procedures, linear programming, neural networks).</li> </ul>			
<i>Skills</i>	The students are able to,... <ul style="list-style-type: none"> <li>• collect empirical data (e.g., data on business processes and data on employee relations, such as job satisfaction), apply business process management and multivariate techniques to the data collected using standard software, and critically evaluate and interpret results gained in order to, for instance, optimize business processes (e.g. in terms of business efficiency) and develop new global HR strategies (e.g., regarding job satisfaction);</li> <li>• critically rethink theoretical concepts and gain analytical ability in organization and human resource management (e.g., critically evaluate the process of acquiring, training, appraising and compensating employees in light of health, safety and fairness concerns in international environments);</li> <li>• map their theoretical understanding of international human resources and business management on actual economic problems and to evaluate how these components affect other fields</li> <li>• use their practical knowledge of the analytical toolset to successfully tackle the management challenges in organization and human resource management in internationally acting companies.</li> <li>• to model and analyze business processes of firms using the essential techniques and standard software (with an emphasis on managing international processes);</li> </ul>			
<b>Personal Competence</b>				
<i>Social Competence</i>	The students are able to... <ul style="list-style-type: none"> <li>• have discussions (with international experts) in the fields of organization and human resource management,</li> <li>• respectfully work in teams,</li> <li>• strengthen their intercultural personal competencies by problem based-learning elements</li> </ul>			
<i>Autonomy</i>	The students are able to independently acquire knowledge in the specific context and to map this knowledge on other or new complex problem			

	fields. They will be able to improve their overall management skills (starting with a structured analysis of the business problem, via developing suitable solutions, to appropriately communicating/presenting solutions developed).
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56
<b>Credit points</b>	6
<b>Examination</b>	Written exam
<b>Examination duration and scale</b>	60 minutes
<b>Assignment for the Following Curricula</b>	International Production Management: Specialisation Management: Elective Compulsory International Management and Engineering: Specialisation I. Electives Management: Elective Compulsory Mechanical Engineering and Management: Specialisation Management: Elective Compulsory

Course L0110: Management, Organization and Human Resource Management	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Christian Ringle
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	<p>This course focuses on multinational firms and advanced issues of management, organizations, and human resource management. Selected topics focus, for example, on:</p> <ul style="list-style-type: none"> <li>• Organizational strategy and design in a global environment</li> <li>• International competition and organizational change</li> <li>• Organizational behavior</li> <li>• Competing in a global environment by cooperation (e.g., virtual organizations, strategic alliances)</li> <li>• Business process design and business process reengineering</li> <li>• International personnel recruitment and placement (e.g., personnel planning, employee testing)</li> <li>• Strategic employee compensation (e.g., strategic pay plans) of multinational firms and employee relations (e.g., employee satisfaction models)</li> <li>• Personnel planning methods</li> <li>• Workplace analysis using specific time measurement methods and approaches</li> </ul>
<b>Literature</b>	<p>Bernardin, H.J.: Human Resource Management: An Experiential Approach, 4e, New York: McGraw-Hill, 2006.</p> <p>Cascio, W.: Managing Human Resources: Productivity, Quality of Work Life, Profits, 6e, New York: McGraw-Hill, 2002.</p> <p>French, W./Bell, C.H./Zawacki, R.A.: Organization Development and Transformation: Managing Effective Change, 5e, Chicago: McGraw-Hill, 1999.</p> <p>Hitt, M.A./Ireland, R.D./Hoskisson, R.E.: Strategic Management: Competitiveness and Globalization, Ohio: Cengage Learning, 2007.</p> <p>Lynch, R.: Strategic Management, 5e, Harlow: Prentice Hall, 2008.</p> <p>Robbins, S.P./Judge, T.A.: Organizational Behavior, 14e, Harlow: Prentice Hall, 2008.</p> <p>Spector, B.: Implementing Organizational Change: Theory and Practice, 3e, Harlow: Prentice Hall, 2006.</p> <p>Selected journal articles.</p>



Course L0111: Management, Organization and Human Resource Management	
<b>Typ</b>	Seminar
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Christian Ringle
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• Analyze organizational strategies and structures of global firms</li> <li>• Model and analyze business processes of international firms using standard software tools</li> <li>• Personnel planning using operations research methodologies (e.g., forecasting procedures, linear programming, neural networks)</li> <li>• Develop and measure causal models for analyzing the satisfaction of employees with different cultural backgrounds</li> <li>• Workplace analysis using specific time measurement methods and approaches</li> </ul>
<b>Literature</b>	<p>Cascio, W.: Managing Human Resources: Productivity, Quality of Work Life, Profits, 6e, New York: McGraw-Hill, 2002.</p> <p>French, W./Bell, C.H./Zawacki, R.A.: Organization Development and Transformation: Managing Effective Change, 5e, New York: McGraw-Hill, 1999.</p> <p>Robbins, S.P./Judge, T.A.: Organizational Behavior, 14e, Harlow: Prentice Hall, 2008.</p> <p>Spector, B.: Implementing Organizational Change: Theory and Practice, 3e, Harlow: Prentice Hall, 2006.</p> <p>Information on the appropriate literature depends on the topics and will therefore be updated each semester.</p>



Course L1586: Applied Statistics	
<b>Typ</b>	Problem-based Learning
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Michael Morlock
<b>Language</b>	DE/EN
<b>Cycle</b>	WiSe
<b>Content</b>	The students receive a problem task, which they have to solve in small groups (n=5). They do have to collect their own data and work with them. The results have to be presented in an executive summary at the end of the course.
<b>Literature</b>	Selbst zu finden

Course L1585: Applied Statistics	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	1
<b>CP</b>	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Lecturer</b>	Prof. Michael Morlock
<b>Language</b>	DE/EN
<b>Cycle</b>	WiSe
<b>Content</b>	The different statistical tests are applied for the solution of realistic problems using actual data sets and the most common used commercial statistical software package (SPSS).
<b>Literature</b>	Student Solutions Manual for Kleinbaum/Kupper/Muller/Nizam's Applied Regression Analysis and Multivariable Methods, 3rd Edition, David G. Kleinbaum Emory University Lawrence L. Kupper University of North Carolina at Chapel Hill, Keith E. Muller University of North Carolina at Chapel Hill, Azhar Nizam Emory University, Published by Duxbury Press, Paperbound © 1998, ISBN/ISSN: 0-534-20913-0

Module M1220: Interfaces and interface-dominated Materials			
<b>Courses</b>			
<b>Title</b>	<b>Typ</b>	<b>Hrs/wk</b>	<b>CP</b>
Nature's Hierarchical Materials (L1663)	Lecture	2	3
Interfaces (L1654)	Lecture	2	3
<b>Module Responsible</b>	Prof. Patrick Huber		
<b>Admission Requirements</b>	None		
<b>Recommended Previous Knowledge</b>	Fundamentals of Materials Science (I and II) and physical chemistry		
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results		
<b>Professional Competence</b>	<p><i>Knowledge</i> The students will be able to explain the properties of advanced materials along with their applications in technology, in particular metallic, ceramic, polymeric, semiconductor, modern composite materials (biomaterials) and nanomaterials.</p> <p><i>Skills</i> The students will be able to select material configurations according to the technical needs and, if necessary, to design new materials considering architectural principles from the micro- to the macroscale. The students will also gain an overview on modern materials science, which enables them to select optimum materials combinations depending on the technical applications.</p>		
<b>Personal Competence</b>	<p><i>Social Competence</i> The students are able to present solutions to specialists and to develop ideas further.</p> <p><i>Autonomy</i> The students are able to ...</p> <ul style="list-style-type: none"> <li>• assess their own strengths and weaknesses.</li> <li>• define tasks independently.</li> </ul>		
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56		
<b>Credit points</b>	6		
<b>Examination</b>	Written exam		
<b>Examination duration and scale</b>	90 min		
<b>Assignment for the Following Curricula</b>	International Production Management: Specialisation Production Technology: Elective Compulsory Materials Science: Specialisation Nano and Hybrid Materials: Elective Compulsory		

Course L1663: Nature's Hierarchical Materials	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Gerold Schneider
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	Biological materials are omnipresent in the world around us. They are the main constituents in plant and animal bodies and have a diversity of functions. A fundamental function is obviously mechanical providing protection and support for the body. But biological materials may also serve as ion reservoirs (bone is a typical example), as chemical barriers (like cell membranes), have catalytic function (such as enzymes), transfer chemical into kinetic energy (such as the muscle), etc. This lecture will focus on materials with a primarily (passive) mechanical function: cellulose tissues (such as wood), collagen tissues (such as tendon or cornea), mineralized tissues (such as bone, dentin and glass sponges). The main goal is to give an introduction to the current knowledge of the structure in these materials and how these structures relate to their (mostly mechanical) functions.
<b>Literature</b>	Peter Fratzl, Richard Weinkamer, Nature's hierarchical materials Progress, in Materials Science 52 (2007) 1263–1334  Journal publications

Course L1654: Interfaces	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Patrick Huber
<b>Language</b>	DE/EN
<b>Cycle</b>	SoSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• Microscopic structure and thermodynamics of interfaces (gas/solid, gas/liquid, liquid/liquid, liquid/solid)</li> <li>• Experimental methods for the study of interfaces</li> <li>• Interfacial forces</li> <li>• wetting</li> <li>• surfactants, foams, bio-membranes</li> <li>• chemical grafting of interfaces</li> </ul>
<b>Literature</b>	"Physics and Chemistry of Interfaces", K.H. Butt, K. Graf, M. Kappl, Wiley-VCH Weinheim (2006)  "Interfacial Science", G.T. Barnes, I.R. Gentle, Oxford University Press (2005)

Module M1253: Selected Topics of Production Technology	
<b>Courses</b>	
<b>Title</b>	<b>Typ</b> <b>Hrs/wk</b> <b>CP</b>
Structure and Properties of Composites (L0513)	Lecture 2 3
Fatigue & Damage Tolerance (L0310)	Lecture 2 3
Joining of Polymer-Metal Lightweight Structures (L0500)	Lecture 2 2
Joining of Polymer-Metal Lightweight Structures (L0501)	Laboratory Course 1 1
Lightweight Design Practical Course (L1258)	Problem-based Learning 3 3
Metallic Materials for Aircraft Applications (L0514)	Lecture 2 3
Reliability in Engineering Dynamics (L0176)	Lecture 2 2
Reliability in Engineering Dynamics (L1303)	Recitation Section (small) 1 2
<b>Module Responsible</b>	Prof. Dieter Krause
<b>Admission Requirements</b>	none
<b>Recommended Previous Knowledge</b>	see lecture description
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results
<b>Professional Competence</b>	<ul style="list-style-type: none"> <li>Students are able to express their extended knowledge and discuss the connection of different special fields or application areas of materials and manufacturing processes</li> <li>Students are qualified to connect different special fields with each other</li> <li>Students can apply specialized solution strategies and new scientific methods in selected areas</li> <li>Students are able to transfer learned skills to new and unknown problems and can develop own solution approaches</li> </ul>
<i>Knowledge</i>	
<i>Skills</i>	
<b>Personal Competence</b>	
<i>Social Competence</i>	Students are able to develop their knowledge and skills by autonomous election of courses.
<i>Autonomy</i>	
<b>Workload in Hours</b>	Depends on choice of courses
<b>Credit points</b>	6
<b>Assignment for the Following Curricula</b>	International Production Management: Specialisation Production Technology: Elective Compulsory

Course L0513: Structure and Properties of Composites	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Examination Form</b>	Klausur
<b>Examination duration and scale</b>	90 Minuten
<b>Lecturer</b>	Prof. Bodo Fiedler
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	<ul style="list-style-type: none"> <li>- Microstructure and properties of the matrix and reinforcing materials and their interaction</li> <li>- Development of composite materials</li> <li>- Mechanical and physical properties</li> <li>- Mechanics of Composite Materials</li> <li>- Laminate theory</li> <li>- Test methods</li> <li>- Non destructive testing</li> <li>- Failure mechanisms</li> <li>- Theoretical models for the prediction of properties</li> <li>- Application</li> </ul>
<b>Literature</b>	Hall, Clyne: Introduction to Composite materials, Cambridge University Press Daniel, Ishai: Engineering Mechanics of Composites Materials, Oxford University Press Mallick: Fibre-Reinforced Composites, Marcel Dekker, New York

Course L0310: Fatigue & Damage Tolerance	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	45 min
Lecturer	Dr. Martin Flamm
Language	EN
Cycle	WiSe
Content	Design principles, fatigue strength, crack initiation and crack growth, damage calculation, counting methods, methods to improve fatigue strength, environmental influences
Literature	Jaap Schijve, Fatigue of Structures and Materials. Kluwer Academic Publisher, Dordrecht, 2001 E. Haibach. Betriebsfestigkeit Verfahren und Daten zur Bauteilberechnung. VDI-Verlag, Düsseldorf, 1989

Course L0500: Joining of Polymer-Metal Lightweight Structures	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Sergio Amancio Filho
Language	EN
Cycle	WiSe
Content	<p><b>Recommended Previous Knowledge:</b></p> <p>Fundamentals of Materials Science and Engineering</p> <p>Basic Knowledge of Science and Technology of Welding and Joining</p> <p><b>Contents:</b></p> <p>The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologies for polymer-metal lightweight structures used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of applications is to be accomplished through theoretical and practical lectures:</p> <p>Theoretical Lectures:</p> <ul style="list-style-type: none"> <li>- Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joining Technology</li> <li>- Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics</li> <li>- Mechanical Fastening of Polymer-Metal Hybrid Structures</li> <li>- Adhesive Bonding of Polymer-Metal Hybrid Structures</li> <li>- Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures</li> <li>- Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures</li> </ul> <p>Laboratory Exercises (will be offered at Helmholtz-Zentrum Geesthacht as a 2-3 days compact course)</p> <ul style="list-style-type: none"> <li>- Joining Processes: Introduction to state-of-the-art friction-based spot welding and joining technologies (Friction Riveting, Friction Spot Joining and Injection Clinching Joining)</li> <li>- Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal joints</li> </ul> <p><b>Learning Outcomes:</b></p> <p>After successful completion of this unit, students should be able to understand the principles of welding and joining of polymer-metal lightweight structures as well as their application fields.</p>
Literature	<ul style="list-style-type: none"> <li>• Lecture Notes and selected papers</li> <li>• J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International</li> <li>• J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers</li> <li>• D.A. Grewell, A. Benatar, J.B. Park, Plastics and Composites Welding Handbook</li> <li>• D. Lohwasser, Z. Chen, Friction Stir Welding, From basics to applications, Woodhead Publishing Limited</li> </ul>

Course L0501: Joining of Polymer-Metal Lightweight Structures	
Typ	Laboratory Course
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Sergio Amancio Filho
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1258: Lightweight Design Practical Course	
Typ	Problem-based Learning
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	SoSe
Content	<p>Development of a sandwich structure made of fibre reinforced plastics</p> <ul style="list-style-type: none"> <li>• getting familiar with fibre reinforced plastics as well as lightweight design</li> <li>• Design of a sandwich structure made of fibre reinforced plastics using finite element analysis (FEA)</li> <li>• Determination of material properties based on sample tests</li> <li>• manufacturing of the structure in the composite lab</li> <li>• Testing of the developed structure</li> <li>• Concept presentation</li> <li>• Self-organised teamwork</li> </ul>
Literature	<ul style="list-style-type: none"> <li>• Schürmann, H., „Konstruieren mit Faser-Kunststoff-Verbunden“, Springer, Berlin, 2005.</li> <li>• Puck, A., „Festigkeitsanalyse von Faser-Matrix-Laminaten“, Hanser, München, Wien, 1996.</li> <li>• R&amp;G, „Handbuch Faserverbundwerkstoffe“, Waldenbuch, 2009.</li> <li>• VDI 2014 „Entwicklung von Bauteilen aus Faser-Kunststoff-Verbund“</li> <li>• Ehrenstein, G. W., „Faserverbundkunststoffe“, Hanser, München, 2006.</li> <li>• Klein, B., „Leichtbau-Konstruktion“, Vieweg &amp; Sohn, Braunschweig, 1989.</li> <li>• Wiedemann, J., „Leichtbau Band 1: Elemente“, Springer, Berlin, Heidelberg, 1986.</li> <li>• Wiedemann, J., „Leichtbau Band 2: Konstruktion“, Springer, Berlin, Heidelberg, 1986.</li> <li>• Backmann, B.F., „Composite Structures, Design, Safety and Innovation“, Oxford (UK), Elsevier, 2005.</li> <li>• Krause, D., „Leichtbau“, In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012.</li> <li>• Schulte, K., Fiedler, B., „Structure and Properties of Composite Materials“, Hamburg, TUHH - TuTech Innovation GmbH, 2005.</li> </ul>

Course L0514: Metallic Materials for Aircraft Applications	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	90 Minuten
Lecturer	Prof. Joachim Albrecht
Language	EN
Cycle	SoSe
Content	<p>Titanium and Titanium alloys: Extraction and melting, phase diagrams, physical properties.</p> <p>CP-Titanium and Alpha alloys: Processing and microstructure, properties and applications.</p> <p>Alpha+Beta alloys: Processing and microstructure, properties and applications.</p> <p>Beta alloys: Processing and microstructure, properties and applications</p> <p>Nickel-base Superalloys: Optimization of creep resistance for gas turbine engines, microstructural constituents and influence of alloying elements, thermomechanical treatment and resulting properties, long time stability at high temperatures</p>
Literature	<p>G. Luetjering, J.C. Williams: Titanium, 2nd ed., Springer, Berlin, Heidelberg, 2007, ISBN 978-3-540-71397</p> <p>C.T. Sims, W.C. Hagel: The Superalloys, John Wiley &amp; Sons, New York, 1972, ISBN 0-471-79207-1</p>



Course L0176: Reliability in Engineering Dynamics	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Examination Form</b>	Klausur
<b>Examination duration and scale</b>	90 min.
<b>Lecturer</b>	Prof. Uwe Weltin
<b>Language</b>	EN
<b>Cycle</b>	SoSe
<b>Content</b>	<p>Method for calculation and testing of reliability of dynamic machine systems</p> <ul style="list-style-type: none"> <li>• Modeling</li> <li>• System identification</li> <li>• Simulation</li> <li>• Processing of measurement data</li> <li>• Damage accumulation</li> <li>• Test planning and execution</li> </ul>
<b>Literature</b>	<p>Bertsche, B.: Reliability in Automotive and Mechanical Engineering. Springer, 2008. ISBN: 978-3-540-33969-4</p> <p>Inman, Daniel J.: Engineering Vibration. Prentice Hall, 3rd Ed., 2007. ISBN-13: 978-0132281737</p> <p>Dresig, H., Holzweißig, F.: Maschinendynamik, Springer Verlag, 9. Auflage, 2009. ISBN 3540876936.</p> <p>VDA (Hg.): Zuverlässigkeitssicherung bei Automobilherstellern und Lieferanten. Band 3 Teil 2, 3. überarbeitete Auflage, 2004. ISSN 0943-9412</p>

Course L1303: Reliability in Engineering Dynamics	
<b>Typ</b>	Recitation Section (small)
<b>Hrs/wk</b>	1
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 46, Study Time in Lecture 14
<b>Examination Form</b>	Klausur
<b>Examination duration and scale</b>	90 min
<b>Lecturer</b>	Prof. Uwe Weltin
<b>Language</b>	EN
<b>Cycle</b>	SoSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

Module M0604: High-Order FEM				
<b>Courses</b>				
<b>Title</b>		<b>Typ</b>	<b>Hrs/wk</b>	<b>CP</b>
High-Order FEM (L0280)		Lecture	3	4
High-Order FEM (L0281)		Recitation Section (large)	1	2
<b>Module Responsible</b>	Prof. Alexander Düster			
<b>Admission Requirements</b>	None			
<b>Recommended Previous Knowledge</b>	Differential Equations 2 (Partial Differential Equations)			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results			
<b>Professional Competence</b>				
<i>Knowledge</i>	Students are able to + give an overview of the different (h, p, hp) finite element procedures. + explain high-order finite element procedures. + specify problems of finite element procedures, to identify them in a given situation and to explain their mathematical and mechanical background.			
<i>Skills</i>	Students are able to + apply high-order finite elements to problems of structural mechanics. + select for a given problem of structural mechanics a suitable finite element procedure. + critically judge results of high-order finite elements. + transfer their knowledge of high-order finite elements to new problems.			
<b>Personal Competence</b>				
<i>Social Competence</i>	Students are able to + solve problems in heterogeneous groups and to document the corresponding results.			
<i>Autonomy</i>	Students are able to + assess their knowledge by means of exercises and E-Learning. + acquaint themselves with the necessary knowledge to solve research oriented tasks.			
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56			
<b>Credit points</b>	6			
<b>Examination</b>	Written exam			
<b>Examination duration and scale</b>	120 min			
<b>Assignment for the Following Curricula</b>	Energy Systems: Core qualification: Elective Compulsory Computational Science and Engineering: Specialisation Scientific Computing: Elective Compulsory International Production Management: Specialisation Production Technology: Elective Compulsory Materials Science: Specialisation Modelling: Elective Compulsory Mechatronics: Technical Complementary Course: Elective Compulsory Product Development, Materials and Production: Core qualification: Elective Compulsory Naval Architecture and Ocean Engineering: Core qualification: Elective Compulsory Theoretical Mechanical Engineering: Core qualification: Elective Compulsory			

Course L0280: High-Order FEM	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	3
<b>CP</b>	4
<b>Workload in Hours</b>	Independent Study Time 78, Study Time in Lecture 42
<b>Lecturer</b>	Prof. Alexander Düster
<b>Language</b>	EN
<b>Cycle</b>	SoSe
<b>Content</b>	1. Introduction 2. Motivation 3. Hierarchic shape functions 4. Mapping functions 5. Computation of element matrices, assembly, constraint enforcement and solution 6. Convergence characteristics 7. Mechanical models and finite elements for thin-walled structures 8. Computation of thin-walled structures 9. Error estimation and hp-adaptivity 10. High-order fictitious domain methods
<b>Literature</b>	[1] Alexander Düster, High-Order FEM, Lecture Notes, Technische Universität Hamburg-Harburg, 164 pages, 2014 [2] Barna Szabo, Ivo Babuska, Introduction to Finite Element Analysis – Formulation, Verification and Validation, John Wiley & Sons, 2011

Course L0281: High-Order FEM	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	1
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 46, Study Time in Lecture 14
<b>Lecturer</b>	Prof. Alexander Düster
<b>Language</b>	EN
<b>Cycle</b>	SoSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

Module M0807: Boundary Element Methods			
<b>Courses</b>			
<b>Title</b>		<b>Typ</b>	<b>Hrs/wk</b> <b>CP</b>
Boundary Element Methods (L0523)		Lecture	2              3
Boundary Element Methods (L0524)		Recitation Section (large)	2              3
<b>Module Responsible</b>	Prof. Otto von Estorff		
<b>Admission Requirements</b>	none		
<b>Recommended Previous Knowledge</b>	Mechanics I (Statics, Mechanics of Materials) and Mechanics II (Hydrostatics, Kinematics, Dynamics) Mathematics I, II, III (in particular differential equations)		
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results		
<b>Professional Competence</b>			
<i>Knowledge</i>	The students possess an in-depth knowledge regarding the derivation of the boundary element method and are able to give an overview of the theoretical and methodical basis of the method.		
<i>Skills</i>	The students are capable to handle engineering problems by formulating suitable boundary elements, assembling the corresponding system matrices, and solving the resulting system of equations.		
<b>Personal Competence</b>			
<i>Social Competence</i>	-		
<i>Autonomy</i>	The students are able to independently solve challenging computational problems and develop own boundary element routines. Problems can be identified and the results are critically scrutinized.		
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56		
<b>Credit points</b>	6		
<b>Examination</b>	Oral exam		
<b>Examination duration and scale</b>			
<b>Assignment for the Following Curricula</b>	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Energy Systems: Core qualification: Elective Compulsory International Production Management: Specialisation Production Technology: Elective Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Product Development, Materials and Production: Core qualification: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory Theoretical Mechanical Engineering: Core qualification: Elective Compulsory		

Course L0523: Boundary Element Methods	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Otto von Estorff
<b>Language</b>	EN
<b>Cycle</b>	SoSe
<b>Content</b>	- Boundary value problems - Integral equations - Fundamental Solutions - Element formulations - Numerical integration - Solving systems of equations (statics, dynamics) - Special BEM formulations - Coupling of FEM and BEM  - Hands-on Sessions (programming of BE routines) - Applications
<b>Literature</b>	Gaul, L.; Fiedler, Ch. (1997): Methode der Randelemente in Statik und Dynamik. Vieweg, Braunschweig, Wiesbaden Bathe, K.-J. (2000): Finite-Elemente-Methoden. Springer Verlag, Berlin

Course L0524: Boundary Element Methods	
<b>Typ</b>	Recitation Section (large)
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Otto von Estorff
<b>Language</b>	EN
<b>Cycle</b>	SoSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

Module M1226: Mechanical Properties			
<b>Courses</b>			
<b>Title</b>		<b>Typ</b>	<b>Hrs/wk</b> <b>CP</b>
Mechanical Behaviour of Brittle Materials (L1661)		Lecture	2                  3
Dislocation Theory of Plasticity (L1662)		Lecture	2                  3
<b>Module Responsible</b>	Dr. Erica Lilleodden		
<b>Admission Requirements</b>	none		
<b>Recommended Previous Knowledge</b>	Basics in Materials Science I/II		
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results		
<b>Professional Competence</b>			
<i>Knowledge</i>	Students can explain basic principles of crystallography, statics (free body diagrams, tractions) and thermodynamics (energy minimization, energy barriers, entropy)		
<i>Skills</i>	Students are capable of using standardized calculation methods: tensor calculations, derivatives, integrals, tensor transformations		
<b>Personal Competence</b>			
<i>Social Competence</i>	Students can provide appropriate feedback and handle feedback on their own performance constructively.		
<i>Autonomy</i>	Students are able to		
	- assess their own strengths and weaknesses		
	- assess their own state of learning in specific terms and to define further work steps on this basis guided by teachers.		
	- work independently based on lectures and notes to solve problems, and to ask for help or clarifications when needed		
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56		
<b>Credit points</b>	6		
<b>Examination</b>	Written exam		
<b>Examination duration and scale</b>	90 min		
<b>Assignment for the Following Curricula</b>	International Production Management: Specialisation Production Technology: Elective Compulsory Materials Science: Core qualification: Compulsory Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Compulsory		

<b>Course L1661: Mechanical Behaviour of Brittle Materials</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Gerold Schneider
<b>Language</b>	DE/EN
<b>Cycle</b>	SoSe
<b>Content</b>	<p><b>Theoretical Strength</b> Of a perfect crystalline material, theoretical critical shear stress</p> <p><b>Real strength of brittle materials</b> Energy release rate, stress intensity factor, fracture criterion</p> <p><b>Scattering of strength of brittle materials</b> Defect distribution, strength distribution, Weibull distribution</p> <p><b>Heterogeneous materials I</b> Internal stresses, micro cracks, weight function,</p> <p><b>Heterogeneous materials II</b> Toughening mechanisms: crack bridging, fibres</p> <p><b>Heterogeneous materials III</b> Toughening mechanisms. Process zone</p> <p><b>Testing methods to determine the fracture toughness of brittle materials</b></p> <p><b>R-curve, stable/unstable crack growth, fractography</b></p> <p><b>Thermal shock</b></p> <p><b>Subcritical crack growth)</b> v-K-curve, life time prediction</p> <p><b>Kriechen</b></p> <p><b>Mechanical properties of biological materials</b></p> <p><b>Examples of use for a mechanically reliable design of ceramic components</b></p>
<b>Literature</b>	<p>D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applications and Design, Elsevier</p> <p>D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press, 1998</p> <p>B.R. Lawn, Fracture of Brittle Solids", Cambridge University Press, 1993</p> <p>D. Munz, T. Fett, Ceramics, Springer, 2001</p> <p>D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992</p>

<b>Course L1662: Dislocation Theory of Plasticity</b>	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Dr. Erica Lilleodden
<b>Language</b>	DE/EN
<b>Cycle</b>	SoSe
<b>Content</b>	<p>This class will cover the principles of dislocation theory from a physical metallurgy perspective, providing a fundamental understanding of the relations between the strength and of crystalline solids and distributions of defects.</p> <p>We will review the concept of dislocations, defining terminology used, and providing an overview of important concepts (e.g. linear elasticity, stress-strain relations, and stress transformations) for theory development. We will develop the theory of dislocation plasticity through derived stress-strain fields, associated self-energies, and the induced forces on dislocations due to internal and externally applied stresses. Dislocation structure will be discussed, including core models, stacking faults, and dislocation arrays (including grain boundary descriptions). Mechanisms of dislocation multiplication and strengthening will be covered along with general principles of creep and strain rate sensitivity. Final topics will include non-FCC dislocations, emphasizing the differences in structure and corresponding implications on dislocation mobility and macroscopic mechanical behavior; and dislocations in finite volumes.</p>
<b>Literature</b>	<p>Vorlesungsskript</p> <p>Aktuelle Publikationen</p> <p>Bücher:</p> <p>Introduction to Dislocations, by D. Hull and D.J. Bacon</p> <p>Theory of Dislocations, by J.P. Hirth and J. Lothe</p> <p>Physical Metallurgy, by Peter Hassen</p>



Module M0563: Robotics				
<b>Courses</b>				
<b>Title</b>		<b>Typ</b>	<b>Hrs/wk</b>	<b>CP</b>
Robotics: Modelling and Control (L0168)		Lecture	3	3
Robotics: Modelling and Control (L1305)		Recitation Section (small)	2	3
<b>Module Responsible</b>	Prof. Uwe Weltin			
<b>Admission Requirements</b>				
<b>Recommended Previous Knowledge</b>	Fundamentals of electrical engineering Broad knowledge of mechanics Fundamentals of control theory			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results			
<b>Professional Competence</b>	<i>Knowledge</i> Students are able to describe fundamental properties of robots and solution approaches for multiple problems in robotics. <i>Skills</i> Students are able to derive and solve equations of motion for various manipulators. Students can generate trajectories in various coordinate systems. Students can design linear and partially nonlinear controllers for robotic manipulators.			
<b>Personal Competence</b>	<i>Social Competence</i> Students are able to work goal-oriented in small mixed groups. <i>Autonomy</i> Students are able to recognize and improve knowledge deficits independently. With instructor assistance, students are able to evaluate their own knowledge level and define a further course of study.			
<b>Workload in Hours</b>	Independent Study Time 110, Study Time in Lecture 70			
<b>Credit points</b>	6			
<b>Examination</b>	Written exam			
<b>Examination duration and scale</b>	120 min			
<b>Assignment for the Following Curricula</b>	Computer Science: Specialisation Intelligence Engineering: Elective Compulsory Computational Science and Engineering: Specialisation Systems Engineering and Robotics: Elective Compulsory International Production Management: Specialisation Production Technology: Elective Compulsory International Management and Engineering: Specialisation II. Mechatronics: Elective Compulsory International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Mechanical Engineering and Management: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory			
Course L0168: Robotics: Modelling and Control				
<b>Typ</b>	Lecture			
<b>Hrs/wk</b>	3			
<b>CP</b>	3			
<b>Workload in Hours</b>	Independent Study Time 48, Study Time in Lecture 42			
<b>Lecturer</b>	Prof. Uwe Weltin			
<b>Language</b>	EN			
<b>Cycle</b>	WiSe			
<b>Content</b>	Fundamental kinematics of rigid body systems Newton-Euler equations for manipulators Trajectory generation Linear and nonlinear control of robots			
<b>Literature</b>	Craig, John J.: Introduction to Robotics Mechanics and Control, Third Edition, Prentice Hall. ISBN 0201-54361-3 Spong, Mark W.; Hutchinson, Seth; Vidyasagar, M. : Robot Modeling and Control. WILEY. ISBN 0-471-64990-2			

Course L1305: Robotics: Modelling and Control	
<b>Typ</b>	Recitation Section (small)
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Uwe Wetlin
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

Module M0629: Intelligent Autonomous Agents and Cognitive Robotics				
<b>Courses</b>				
<b>Title</b>		<b>Typ</b>	<b>Hrs/wk</b>	<b>CP</b>
Intelligent Autonomous Agents and Cognitive Robotics (L0341)		Lecture	2	4
Intelligent Autonomous Agents and Cognitive Robotics (L0512)		Recitation Section (small)	2	2
<b>Module Responsible</b>	Rainer Marrone			
<b>Admission Requirements</b>				
<b>Recommended Previous Knowledge</b>	Vectors, matrices, Calculus, propositional Logic, Stochastics (in particular practical representation formalisms such as Bayesian networks, dynamic Bayesian networks, hidden Markov models, Kalman filters)			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results			
<b>Professional Competence</b>				
<i>Knowledge</i>	Students can explain the agent abstraction, define intelligence in terms of rational behavior, and give details about agent design (goals, utilities, environments). They can describe the main features of environments. The notion of adversarial agent cooperation can be discussed in terms of decision problems and algorithms for solving these problems. For dealing with uncertainty in real-world scenarios, students can summarize how Bayesian networks can be employed as a knowledge representation and reasoning formalism in static and dynamic settings. In addition, students can define decision making procedures in simple and sequential settings, with and with complete access to the state of the environment. In this context, students can describe techniques for solving (partially observable) Markov decision problems, and they can recall techniques for measuring the value of information. Students can identify techniques for simultaneous localization and mapping, and can explain planning techniques for achieving desired states. Students can explain coordination problems and decision making in a multi-agent setting in term of different types of equilibria, social choice functions, voting protocol, and mechanism design techniques.			
<i>Skills</i>	Students can select an appropriate agent architecture for concrete agent application scenarios. For simplified agent application students can derive decision trees and apply basic optimization techniques. For those applications they can also create Bayesian networks/dynamic Bayesian networks and apply bayesian reasoning for simple queries. Students can also name and apply different sampling techniques for simplified agent scenarios. For simple and complex decision making students can compute the best action or policies for concrete settings. In multi-agent situations students will apply techniques for finding different equilibria states, e.g., Nash equilibria. For multi-agent decision making students will apply different voting protocols and compare and explain the results.			
<b>Personal Competence</b>				
<i>Social Competence</i>	Students are able to discuss their solutions to problems with others. They communicate in English			
<i>Autonomy</i>	Students are able of checking their understanding of complex concepts by solving variants of concrete problems			
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56			
<b>Credit points</b>	6			
<b>Examination</b>	Written exam			
<b>Examination duration and scale</b>	90 minutes			
<b>Assignment for the Following Curricula</b>	International Production Management: Specialisation Production Technology: Elective Compulsory International Management and Engineering: Specialisation II. Information Technology: Elective Compulsory Mechatronics: Technical Complementary Course: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory			

Course L0341: Intelligent Autonomous Agents and Cognitive Robotics	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	4
<b>Workload in Hours</b>	Independent Study Time 92, Study Time in Lecture 28
<b>Lecturer</b>	Rainer Marrone
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	<ul style="list-style-type: none"> <li>• Definition of agents, rational behavior, goals, utilities, environment types</li> <li>• Adversarial agent cooperation: Agents with complete access to the state(s) of the environment, games, Minimax algorithm, alpha-beta pruning, elements of chance</li> <li>• Uncertainty: Motivation: agents with no direct access to the state(s) of the environment, probabilities, conditional probabilities, product rule, Bayes rule, full joint probability distribution, marginalization, summing out, answering queries, complexity, independence assumptions, naive Bayes, conditional independence assumptions</li> <li>• Bayesian networks: Syntax and semantics of Bayesian networks, answering queries revised (inference by enumeration), typical-case complexity, pragmatics: reasoning from effect (that can be perceived by an agent) to cause (that cannot be directly perceived).</li> <li>• Probabilistic reasoning over time: Environmental state may change even without the agent performing actions, dynamic Bayesian networks, Markov assumption, transition model, sensor model, inference problems: filtering, prediction, smoothing, most-likely explanation, special cases: hidden Markov models, Kalman filters, Exact inferences and approximations</li> <li>• Decision making under uncertainty: Simple decisions: utility theory, multivariate utility functions, dominance, decision networks, value of information Complex decisions: sequential decision problems, value iteration, policy iteration, MDPs Decision-theoretic agents: POMDPs, reduction to multidimensional continuous MDPs, dynamic decision networks</li> <li>• Simultaneous Localization and Mapping</li> <li>• Planning</li> <li>• Game theory (Golden Balls: Split or Share) Decisions with multiple agents, Nash equilibrium, Bayes-Nash equilibrium</li> <li>• Social Choice Voting protocols, preferences, paradoxes, Arrow's Theorem,</li> <li>• Mechanism Design Fundamentals, dominant strategy implementation, Revelation Principle, Gibbard-Satterthwaite Impossibility Theorem, Direct mechanisms, incentive compatibility, strategy-proofness, Vickrey-Groves-Clarke mechanisms, expected externality mechanisms, participation constraints, individual rationality, budget balancedness, bilateral trade, Myerson-Satterthwaite Theorem</li> </ul>
<b>Literature</b>	<ol style="list-style-type: none"> <li>1. Artificial Intelligence: A Modern Approach (Third Edition), Stuart Russell, Peter Norvig, Prentice Hall, 2010, Chapters 2-5, 10-11, 13-17</li> <li>2. Probabilistic Robotics, Thrun, S., Burgard, W., Fox, D. MIT Press 2005</li> <li>3. Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, Yoav Shoham, Kevin Leyton-Brown, Cambridge University Press, 2009</li> </ol>

Course L0512: Intelligent Autonomous Agents and Cognitive Robotics	
<b>Typ</b>	Recitation Section (small)
<b>Hrs/wk</b>	2
<b>CP</b>	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Lecturer</b>	Rainer Marrone
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

Module M0633: Industrial Process Automation				
<b>Courses</b>				
<b>Title</b>		<b>Typ</b>	<b>Hrs/wk</b>	<b>CP</b>
Industrial Process Automation (L0344)		Lecture	2	3
Industrial Process Automation (L0345)		Recitation Section (small)	2	3
<b>Module Responsible</b>	Prof. Alexander Schlaefer			
<b>Admission Requirements</b>	None			
<b>Recommended Previous Knowledge</b>	mathematics and optimization methods principles of automata principles of algorithms and data structures programming skills			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results			
<b>Professional Competence</b>				
<i>Knowledge</i>	The students can evaluate and assess discrete event systems. They can evaluate properties of processes and explain methods for process analysis. The students can compare methods for process modelling and select an appropriate method for actual problems. They can discuss scheduling methods in the context of actual problems and give a detailed explanation of advantages and disadvantages of different programming methods.			
<i>Skills</i>	The students are able to develop and model processes and evaluate them accordingly. This involves taking into account optimal scheduling, understanding algorithmic complexity and implementation using PLCs.			
<b>Personal Competence</b>				
<i>Social Competence</i>	The students work in teams to solve problems.			
<i>Autonomy</i>	The students can reflect their knowledge and document the results of their work.			
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56			
<b>Credit points</b>	6			
<b>Examination</b>	Written exam			
<b>Examination duration and scale</b>	90 minutes			
<b>Assignment for the Following Curricula</b>	Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation General Process Engineering: Elective Compulsory Computer Science: Specialisation Intelligence Engineering: Elective Compulsory Electrical Engineering: Specialisation Control and Power Systems: Elective Compulsory Computational Science and Engineering: Specialisation Scientific Computing: Elective Compulsory Computational Science and Engineering: Specialisation Systems Engineering and Robotics: Elective Compulsory International Production Management: Specialisation Production Technology: Elective Compulsory International Management and Engineering: Specialisation II. Mechatronics: Elective Compulsory Mechanical Engineering and Management: Specialisation Mechatronics: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Numerics and Computer Science: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Process Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Process Engineering: Specialisation Process Engineering: Elective Compulsory			

Course L0344: Industrial Process Automation	
<b>Typ</b>	Lecture
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Alexander Schlaefer
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	<ul style="list-style-type: none"> <li>- foundations of problem solving and system modeling, discrete event systems</li> <li>- properties of processes, modeling using automata and Petri-nets</li> <li>- design considerations for processes (mutex, deadlock avoidance, liveness)</li> <li>- optimal scheduling for processes</li> <li>- optimal decisions when planning manufacturing systems, decisions under uncertainty</li> <li>- software design and software architectures for automation, PLCs</li> </ul>
<b>Literature</b>	J. Lunze: „Automatisierungstechnik“, Oldenbourg Verlag, 2012 Reisig: Petrinetze: Modellierungstechnik, Analysemethoden, Fallstudien; Vieweg+Teubner 2010 Hruz, Zhou: Modeling and Control of Discrete-event Dynamic Systems; Springer 2007 Li, Zhou: Deadlock Resolution in Automated Manufacturing Systems, Springer 2009 Pinedo: Planning and Scheduling in Manufacturing and Services, Springer 2009

Course L0345: Industrial Process Automation	
<b>Typ</b>	Recitation Section (small)
<b>Hrs/wk</b>	2
<b>CP</b>	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Lecturer</b>	Prof. Alexander Schlaefer
<b>Language</b>	EN
<b>Cycle</b>	WiSe
<b>Content</b>	See interlocking course
<b>Literature</b>	See interlocking course

## Thesis

### Module M-002: Master Thesis

#### Courses

Title	Typ	Hrs/wk	CP
<b>Module Responsible</b>	Professoren der TUHH		
<b>Admission Requirements</b>	<ul style="list-style-type: none"> <li>According to General Regulations §24 (1):</li> </ul> <p>At least 126 ECTS credit points have to be achieved in study programme. The examinations board decides on exceptions.</p>		
<b>Recommended Previous Knowledge</b>			
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results		
<b>Professional Competence</b>	<ul style="list-style-type: none"> <li>The students can use specialized knowledge (facts, theories, and methods) of their subject competently on specialized issues.</li> <li>The students can explain in depth the relevant approaches and terminologies in one or more areas of their subject, describing current developments and taking up a critical position on them.</li> <li>The students can place a research task in their subject area in its context and describe and critically assess the state of research.</li> </ul>		
<i>Knowledge</i>			
<i>Skills</i>	<p>The students are able:</p> <ul style="list-style-type: none"> <li>To select, apply and, if necessary, develop further methods that are suitable for solving the specialized problem in question.</li> <li>To apply knowledge they have acquired and methods they have learnt in the course of their studies to complex and/or incompletely defined problems in a solution-oriented way.</li> <li>To develop new scientific findings in their subject area and subject them to a critical assessment.</li> </ul>		
<b>Personal Competence</b>	<p>Students can</p> <ul style="list-style-type: none"> <li>Both in writing and orally outline a scientific issue for an expert audience accurately, understandably and in a structured way.</li> <li>Deal with issues competently in an expert discussion and answer them in a manner that is appropriate to the addressees while upholding their own assessments and viewpoints convincingly.</li> </ul>		
<i>Social Competence</i>			
<i>Autonomy</i>	<p>Students are able:</p> <ul style="list-style-type: none"> <li>To structure a project of their own in work packages and to work them off accordingly.</li> <li>To work their way in depth into a largely unknown subject and to access the information required for them to do so.</li> <li>To apply the techniques of scientific work comprehensively in research of their own.</li> </ul>		
<b>Workload in Hours</b>	Independent Study Time 900, Study Time in Lecture 0		
<b>Credit points</b>	30		
<b>Examination</b>	according to Subject Specific Regulations		
<b>Examination duration and scale</b>	see FSPO		
<b>Assignment for the Following Curricula</b>	Civil Engineering: Thesis: Compulsory Bioprocess Engineering: Thesis: Compulsory Chemical and Bioprocess Engineering: Thesis: Compulsory Computer Science: Thesis: Compulsory Electrical Engineering: Thesis: Compulsory Energy and Environmental Engineering: Thesis: Compulsory Energy Systems: Thesis: Compulsory Environmental Engineering: Thesis: Compulsory Aircraft Systems Engineering: Thesis: Compulsory Global Innovation Management: Thesis: Compulsory Computational Science and Engineering: Thesis: Compulsory Information and Communication Systems: Thesis: Compulsory International Production Management: Thesis: Compulsory International Management and Engineering: Thesis: Compulsory Joint European Master in Environmental Studies - Cities and Sustainability: Thesis: Compulsory Logistics, Infrastructure and Mobility: Thesis: Compulsory Materials Science: Thesis: Compulsory Mechanical Engineering and Management: Thesis: Compulsory Mechatronics: Thesis: Compulsory Biomedical Engineering: Thesis: Compulsory Microelectronics and Microsystems: Thesis: Compulsory Product Development, Materials and Production: Thesis: Compulsory Renewable Energies: Thesis: Compulsory Naval Architecture and Ocean Engineering: Thesis: Compulsory		

Ship and Offshore Technology: Thesis: Compulsory
Theoretical Mechanical Engineering: Thesis: Compulsory
Process Engineering: Thesis: Compulsory
Water and Environmental Engineering: Thesis: Compulsory