TUHH
Hamburg
University of
Technology

Module Manual

Master of Science (M.Sc.)

Product Development, Materials and Production

Cohort: Winter Term 2019

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Program description

Content

The consecutive master program "product development, materials and production" 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 phases of the product creation process are covered: strategic product planning; systematic and methodical development of products including concept development, design, material selection, simulation and testing; production including its planning and control, the use of modern production methods and high-performance materials. Students specialize in one of the three disciplines and acquire the ability to work at the interfaces of the disciplines. Students can choose from a wide range of electives and customize their studies very flexibly according to their individual needs and interests.

Career prospects

The consecutive Master course "product development, materials and production" prepares graduates for a wide range of job profiles in mechanical engineering. Graduates can work directly in their specialization area: product development, materials or production. 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. designer, simulation engineer, production planner) or subsequently qualify for demanding management tasks in the technical area (e.g. project, group, or team leader; R&D or production manager or technical director). The program is designed to be universal and allows graduates to work in a variety of different industrial sectors (especially in mechanical engineering) and with different products.

Learning target

Graduates of the program are able to transfer the individually acquired specialized knowledge to new unknown topics, to grasp, 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 team work. They are capable of presenting and arguing the results to professionals. They can estimate their own strengths and weaknesses as well as possible consequences of their actions. They are capable to familiarize themselves with complex tasks, define new tasks, develop the necessary knowledge for solving it and to systematically apply appropriate means.

Product Development

In the product development specialization, graduates learn to work systematically and methodically on challenging design tasks. They have a wide knowledge of new development methods, are able to select appropriate solution strategies and use these autonomously to develop new products. They are qualified to use the approaches of integrated product development, such as simulation or modern testing procedures, for example for the development of lightweight products. With their additional knowledge about modern high-performance materials and production processes graduates can design products on the cutting edge of technology, calculate and actively promote the development of products using modern methods.

M**aterials**

Graduates of the discipline materials are able to work in the development, production and application of materials based on a natural scientific education. The material-oriented graduates can identify new fields of application and make the application-specific selection of the material under consideration of function, costs and quality.

Production
Graduates of the discipline production have in-depth knowledge of various production and manufacturing processes. They are qualified to evaluate those in the context of geometry creation, error control, cost effectiveness and humanization of work and are able to consider the interfaces of technology, organization and human, holistically.

Program structure

The course is designed modular and is based on the university-wide standardized course structure with uniform module sizes (multiples of six credit points (CP)). The mechanical engineering course combines the disciplines product development, materials and production and allows the deepening in one of these specializations. The students can broadly personalize their studies due to high number and variety of elective courses.

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

- Finite element analysis and vibration theory (12 CP)
- Fundamental elective courses (catalog) (12 CP)
- Practical Course (6 CP)
- Complementary courses business and management (catalog) (6 CP)
- Nontechnical elective complementary courses (catalog) (6 CP).

Students specialize by selecting one of the following areas, each covering 36 credit points:

- Product development (product development methods, lightweight design)
- Production (production management, production technology)
- Materials (engineering materials).

Within each area of specialization three modules with six credit points are mandatory. An additional 18 credits can be chosen form a module catalog containing modules with a size of six credits. Instead, open modules can be attend to the maximum extent of twelve 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 extend their knowledge and skills in advanced engineering subjects (e.g. vibration theory), in business and management as well as other non-technical topics. Students deepen their autonomous methodological and scientific problem solving skills in the field of product development, materials and production by attending a practical course and by writing a scientific project work.

Module M0523: Business & Management

Module Responsible	Prof. Matthias Meyer
Admission Requirements	None
Recommended Previous Knowledge	None
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students are able to find their way around selected special areas of management within the scope of business management. • Students are able to explain basic theories, categories, and models in selected special areas of business management. • Students are able to interrelate technical and management knowledge.
Skills	• Students are able to apply basic methods in selected areas of business management. • Students are able to explain and give reasons for decision proposals on practical issues in areas of business management.
Personal Competence	
Social Competence	• Students are able to communicate in small interdisciplinary groups and to jointly develop solutions for complex problems
Autonomy	• Students are capable of acquiring necessary knowledge independently by means of research and preparation of material.
Workload in Hours	Depends on choice of courses
Credit points	6

Course L1486: Business Model Generation & Green Technologies	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	0
Lecturer	Prof. Michael Prange
Language	EN
Cycle	WiSe
Content	• Overview about Green Technologies • Introduction to Business Model Generation • Business model patterns • Design techniques for business ideas • Strategy development • Value proposition architecture • Business plan and financing • Component-based foundations • Lean Entrepreneurship Based on examples and case studies primarily in the field of green technologies, students learn the basics of Business Model Generation and will be able to develop business models and to evaluate start-up projects.
Literature	Präsentationsfolien, Beispiele und Fallstudien aus der Vorlesung Presentation slides, examples and case studies from the lecture

Course L1487: Corporate Entrepreneurship & Green Innovation	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	
Lecturer	Prof. Michael Prange
Language	EN
Cycle	WiSe
Content	• Overview about Green Innovation • Introduction to Corporate Entrepreneurship • Entrepreneurial thinking in established companies • Entrepreneurs and managers • Strategic innovation processes • Corporate Venturing • Product Service Systems • Open Innovation • User Innovation Based on examples and case studies primarily in the field of green innovation, students learn the basics of corporate entrepreneurship and will be able to implement entrepreneurial thinking in established companies and to describe strategic innovation processes.
Literature	Präsentationsfolien, Beispiele und Fallstudien aus der Vorlesung Presentation slides, examples and case studies from the lecture

Course L1280: Creation of Business Opportunities	
Typ	Project-/problem-based Learning
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Examination Form	Referat
Examination duration and scale	30 Minuten
Lecturer	Prof. Christoph Ihl
Language	EN
Cycle	SoSe
Content	Important note: This course is part of an 6 ECTS module consisting of two courses "Entrepreneurship” & “Creation of Business Opportunities”, which have to be taken together in one semester. Startups are temporary, team-based organizations, which can form both within and outside of established companies, to pursue one central objective: taking a new venture idea to market by designing a business model that can be scaled to a full-grown company. In this course, students will form startup teams around self-selected ideas and run through the process just like real startups would do in the first three months of intensive work. Startup Engineering takes an incremental and iterative approach, in that it favors variety and alternatives over one detailed, linear five-year business plan to reach steady state operations. From a problem solving and systems thinking perspective, student teams create different possible versions of a new venture and alternative hypotheses about value creation for customers and value capture vis-à-vis competitors. We will draw on recent scientific findings about international success factors of new venture design. To test critical hypotheses early on, student teams engage in scientific, evidence-based, experimental trial-and-error learning process that measures real progress. Upon completion of this course, students will be able to: · Apply a modern innovation toolkit relevant in both the corporate & startup world · Analyze given business opportunities in terms of its constituent elements · Design new business models by gathering and combining relevant ideas, facts and information · Evaluate business opportunities and derive judgment about next steps & decisions Course language is English, but participants can decide to give their graded presentations in German. Students are invited to apply to this course module already with a startup idea and/ or team, but this is not a requirement! We will form teams and ideas in the beginning of the course. Class meetings have alternate intervals of lecture inputs, teamwork, mentoring, and peer feedback. Attendance is mandatory for at least 80% of class time due to large proportion of teamwork sessions. Student teams give three presentations and submit them with backup analyses. Grading scheme: · Startup discovery presentation after 5 weeks: 30% · Startup validation presentation after 10 weeks: 30% · Final startup pitches after 13 weeks: 40%
Literature	• Blank, S. & Dorf, B. (2012). The startup owner's manual. • Gans, J. & Stern, S. (2016). Entrepreneurial Strategy. • Osterwalder, A. & Yves, P. (2010). Business model generation. • Maurya, A. (2012). Running lean: Iterate from plan A to a plan that works. • Maurya, A. (2016). Scaling lean: Mastering the Key Metrics for Startup Growth. • Wilcox, J. (2016). FOCUS Framework: How to Find Product-Market Fit.

Course L2348: Drivers of success for projects	
Typ	Project-/problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	0
Lecturer	Lucia Pohl
Language	DE
Cycle	WiSe/SoSe
Content	
Literature	

Course L1384: Intellectual Property	
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	
Lecturer	Janna Thomsen, Cathérine Elkemann
Language	DE
Cycle	WiSe
Content	• Trademark law • Copyright • Patent law • Know-how, supplementary performance protection, et al. • Enforcement of intellectual property rights • Licensing of intellectual property rights • Hypothecation, security assignment and evaluation of intellectual property rights
Literature	Quellen und Materialen wird im Internet zur Verfügung gestellt

Course L2347: Human resource management for engineers	
Typ	Project-/problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	0
Lecturer	Helge Kochskämper
Language	DE
Cycle	WiSe
Content	
Literature	

Course L1711: Innovation Debates	
Typ	Project-/problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Fachtheoretisch-fachpraktische Arbeit
Examination duration and scale	3 Präsentationen der schriftlichen Ausarbeitung à 20 Minutes
Lecturer	Prof. Daniel Heiner Ehls
Language	EN
Cycle	WiSe
Content	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. 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.
Literature	1. Course notes and materials provided before the lecture 2. Leiblein/ Ziedonis (2011): Technology Strategy and innovation management. Edward Elgar Publishing Ltd (optional)

Course L0940: Innovation Management	
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	
Lecturer	Prof. Cornelius Herstatt
Language	DE/EN
Cycle	SoSe
Content	Innovation is key to corporate growth and sustainibility. In this lecture Prof. Herstatt presents a systematic way from generating ideas to the successful implementation of innovations. **The lecture is presented in German language only**
Literature	• Goffin, K., Herstatt, C. and Mitchell, R. (2009): Innovationsmanagement: Strategie und effektive Umsetzung von Innovationsprozessen mit dem Pentathlon-Prinzip, München: Finanzbuch Verlag **Weiterführende Literatur** • Innovationsmanagement Juergen Hauschildt • F + E Management Specht, G. / Beckmann, Chr. • Management der frühen Innovationsphasen Cornelius Herstatt, Birgit Verworn (im TUHH-Intranet auch als E-Book verfügbar) • Bringing Technology and Innovation Into the Boardroom • weitere Literaturempfehlungen auf Anfrage

Course L0161: Internationalization Strategies	
Typ	Project-/problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	20-30 Minuten Referat einschl. Diskussionsleitung plus schriftliche Ausarbeitung (ca. 10 Seiten)
Lecturer	Prof. Thomas Wrona
Language	EN
Cycle	SoSe
Content	• Introduction • Internationalization of markets • Measuring internationalization of firms • Target market strategies • Market entry strategies • Timing strategies • Allocation strategies • Working in small teams on close-to-reality problems based on presented theories • Paper writing on developed solution to the given problem/project e.g. market attractiveness analysis; development of market entry strategy for a hypothetical product in a given region
Literature	• Bartlett/Ghoshal (2002): Managing Across Borders, The Transnational Solution, 2nd edition, Boston • Buckley, P.J./Ghauri, P.N. (1998), The Internationalization of the Firm, 2nd edition • Czinkota, Ronkainen, Moffett, Marinova, Marinov (2009), International Business, Hoboken • Dunning, J.H. (1993), The Globalization of Business: The Challenge of the 1990s, London • Ghoshal, S. (1987), Global Strategy: An Organizing Framework, Strategic Management Journal, p. 425-440 • Praveen Parboteeah, K.,Cullen, J.B. (2011) , Strategic International Management, International 5th Edition • Rugman, A.M./Collinson, S. (2012): International Business, 6th Edition, Essex 2012

Course L2350: Leadership	
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	60 min
Lecturer	Dr. Thomas Kosin
Language	DE
Cycle	WiSe
Content	
Literature	

Course L1231: Management and Leadership	
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	60 Minuten
Lecturer	Prof. Christian Ringle
Language	DE
Cycle	SoSe
Content	• definitions and foundations of strategic management • strategic planning • strategic analysis and forecast • development of strategic options • strategy evaluaton, implementation and strategic control
Literature	- Bea, F.X.; Haas, J.: Strategisches Management, 5. Auflage, Stuttgart 2009. - Dess, G. G.; Lumpkin, G. T.; Eisner, A. B.: Strategic management: Creating competitive advantages, Boston 2010 - Hahn, D.; Taylor, B.: Strategische Unternehmensplanung: Strategische Unternehmensführung, 9. Auflage, Heidelberg 2006. - Hinterhuber, H.H.: Strategische Unternehmensführung Bd. 1: Strategisches Denken, 7. Aufl., Berlin u. a. 2004 - Hinterhuber, H.H.: Strategische Unternehmensführung Bd. 2: Strategisches Handeln, 7. Aufl., Berlin u. a. 2004 - Hungenberg, H.: Strategisches Management in Unternehmen, 6. Auflage, Wiesbaden 2011 - Johnson, G.; Scholes, K.; Whittington, R.: Strategisches Management. Eine Einführung, 9. Auflage, München 2011 - Macharzina, K.: Unternehmensführung: Das internationale Managementwissen, 7. Auflage, Wiesbaden 2010. - Porter, M.E.: Competitive strategy, New York 1980 (deutsche Ausgabe: Wettbewerbsstrategie, 10. Aufl., Frankfurt am Main 1999) - Welge, M. K.; Al-Laham, A.: Strategisches Management, 5. Auflage, Wiesbaden 2008.

Course L1857: Entrepreneurial Management	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	20 Minuten inklusive 15 Seiten Ausarbeitung
Lecturer	Prof. Christoph Ihl
Language	EN
Cycle	WiSe
Content	Important note: This course is part of an 6 ECTS module consisting of the three courses "Startup Engineering", "Startup Engineering Project" and "Entrepreneurship Management", which have to be taken together in one semester. Startups are temporary, team-based organizations, which can form both within and outside of established companies, to pursue one central objective: taking a new venture idea to market by designing a business model that can be scaled to a full-grown company. In this course, students will form startup teams around self-selected ideas and run through the process just like real startups would do in the first three months of intensive work. Startup Engineering takes an incremental and iterative approach, in that it favors variety and alternatives over one detailed, linear five-year business plan to reach steady state operations. From a problem solving and systems thinking perspective, student teams create different possible versions of a new venture and alternative hypotheses about value creation for customers and value capture vis-à-vis competitors. To test critical hypotheses early on, student teams engage in an evidence-based, experimental trial-and-error learning process that measures real progress. Upon completion of this course, students will be able to: · Apply a modern innovation toolkit relevant in both the corporate & startup world · Analyze given business opportunities in terms of its constituent elements · Design new business models by gathering and combining relevant ideas, facts and information · Evaluate business opportunities and derive judgment about next steps & decisions Course language is English, but participants can decide to give their graded presentations in German. Students are invited to apply to this course module already with a startup idea and/ or team, but this is not a requirement! We will form teams and ideas in the beginning of the course. Class meetings have alternate intervals of lecture inputs, teamwork, mentoring, and peer feedback. Attendance is mandatory for at least 80% of class time due to large proportion of teamwork sessions. Student teams give three presentations and submit them with backup analyses. Grading scheme: · Startup discovery presentation after 5 weeks: 30% · Startup validation presentation after 10 weeks: 30% · Final startup pitches after 13 weeks: 40%
Literature	• Blank, S. & Dorf, B. (2012). The startup owner's manual. • Gans, J. & Stern, S. (2016). Entrepreneurial Strategy. • Osterwalder, A. & Yves, P. (2010). Business model generation. • Maurya, A. (2012). Running lean: Iterate from plan A to a plan that works. • Maurya, A. (2016). Scaling lean: Mastering the Key Metrics for Startup Growth. • Wilcox, J. (2016). FOCUS Framework: How to Find Product-Market Fit.

Course L0863: Marketing	
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	
Lecturer	Prof. Christian Lüthje
Language	EN
Cycle	WiSe
Content	**Contents** Basics of Marketing The philosophy and fundamental aims of marketing. Contrasting different marketing fields (e.g. business-to-consumer versus business-to-business marketing). The process of marketing planning, implementation and controlling Strategic Marketing Planning How to find profit opportunities? How to develop cooperation, internationalization, timing, differentiation and cost leadership strategies? Market-oriented Design of products and services How can companies get valuable customer input on product design and development? What is a service? How can companies design innovative services supporting the products? Pricing What are the underlying determinants of pricing decision? Which pricing strategies should companies choose over the life cycle of

	products? What are special forms of pricing on business-to-business markets (e.g. competitive bidding, auctions)? Marketing Communication What is the role of communication and advertising in business-to-business markets? Why advertise? How can companies manage communication over advertisement, exhibitions and public relations? Sales and Distribution How to build customer relationship? What are the major requirements of industrial selling? What is a distribution channel? How to design and manage a channel strategy on business-to-business markets? **Knowledge** Students will gain an introduction and good overview of • Specific challenges in the marketing of innovative goods and services • Key strategic areas in strategic marketing planning (cooperation, internationalization, timing) • Tools for information gathering about future customer needs and requirements • Fundamental pricing theories and pricing methods • Main communication instruments • Marketing channels and main organizational issues in sales management • Basic approaches for managing customer relationship **Skills** Based on the acquired knowledge students will be able to: • Design market timing decisions • Make decisions for marketing-related cooperation and internationalization activities • Manage the challenges of market-oriented development of new products and services • Translate customer needs into concepts, prototypes and marketable offers • Determine the perceived quality of an existing product or service using advanced elicitation and measurement techniques that fit the given situation • Analyze the pricing alternatives for products and services • Make strategic sales decisions for products and services (i.e. selection of sales channels) • Analyze the value of customers and apply customer relationship management tools **Social Competence** The students will be able to • have fruitful discussions and exchange arguments • present results in a clear and concise way • carry out respectful team work **Self-reliance** The students will be able to • Acquire knowledge independently in the specific context and to map this knowledge on other new complex problem fields. • Consider proposed business actions in the field of marketing and reflect on them.
Literature	Homburg, C., Kuester, S., Krohmer, H. (2009). Marketing Management, McGraw-Hill Education, Berkshire, extracts p. 31-32, p. 38-53, 406-414, 427-431 Bingham, F. G., Gomes, R., Knowles, P. A. (2005). Business Marketing, McGraw-Hill Higher Education, 3rd edition, 2004, p. 106-110 Besanke, D., Dranove, D., Shanley, M., Schaefer, S. (2007), Economics of strategy, Wiley, 3rd edition, 2007, p. 149-155 Hutt, M. D., Speh, T.W. (2010), Business Marketing Management, 10th edition, South Western, Lengage Learning, p. 112-116

Course L2440: Mergers & Acquistions (M&A)	
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	60 min
Lecturer	Prof. Philipp Haberstock
Language	DE
Cycle	SoSe
Content	
Literature	

Course L0709: Project Management	
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	
Lecturer	Prof. Carlos Jahn
Language	EN
Cycle	WiSe
Content	The lecture “project management” aims at characterizing typical phases of projects. Important contents are: possible tasks, organization, techniques and tools for initiation, definition, planning, management and finalization of projects. This will also be deepened by exercises within the framework of the event. The following topics will be covered in the lecture: • SMART, Work Breakdown Structure, Operationalization, Goals relation matrix • Metra-Potential Method (MPM), Critical-Path Method (CPM), Program evaluation and review technique (PERT) • Milestone Analysis, Earned Value Analyis (EVA) • Progress reporting, Tracing of project goals, deadlines and costs, Project Management Control Loop, Maturity Level Assurance (MLA) • Risk Management, Failure Mode and Effects Analysis (FMEA), Risk Matrix
Literature	Project Management Institute (2017): A Guide to the Project Management Body of Knowledge (PMBOK® Guide) 6. Aufl. Newtown Square, PA, USA: Project Management Institute. DeMarco, Tom (1997). The Deadline: A Novel About Project Management. DIN Deutsches Institut für Normung e.V. (2009). Projektmanagement - Projektmanagementsysteme - Teil 5: Begriffe. (DIN 69901-5) Frigenti, Enzo and Comninos, Dennis (2002). The Practice of Project Management. Haberfellner, Reinhard (2015). Systems Engineering: Grundlagen und Anwendung Harrison, Frederick and Lock, Dennis (2004). Advanced Project Management: A Structured Approach. Heyworth, Frank (2002). A Guide to Project Management. ISO - International Organization for Standardization (2012). Guidance on Project Management. (21500:2012(E)) Kerzner, Harold (2013). Project Management: A Systems Approach to Planning, Scheduling, and Controlling. Lock, Dennis (2018). Project Management. Martinelli, Russ J. and Miloševic, Dragan (2016). Project Management Toolbox: Tools and Techniques for the Practicing Project Manager. Murch, Richard (2011). Project Management: Best Practices for IT Professionals. Patzak, Gerold and Rattay, Günter (2009). Projektmanagement: Leitfaden zum Management von Projekten, Projektportfolios, Programmen und projektorientierten Unternehmen.

Course L1385: Project Management in Industrial Practice	
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	
Lecturer	Dipl.-Ing. Wilhelm Radomsky
Language	DE
Cycle	WiSe
Content	• Project management in a company • Project life cycle / Project environment • Project structuring / Project planning • Deployment of methods / Team development • Contract / Risk / Change management • Multi-project management / Quality management • Project controlling / Reporting • Project organization / Project conclusion
Literature	• Brown (1998): Erfolgreiches Projektmanagement in 7 Tagen • Burghardt (2002): Einführung in Projektmanagement • Cleland / King (1997): Project Management Handbook • Hemmrich, Harrant (2002): Projektmanagement, In 7 Schritten zum Erfolg • Kerzner (2003): Projektmanagement • Litke (2004): Projektmanagement • Madauss (2005): Handbuch Projektmanagement • Patzak / Rattay (2004): Projektmanagement • PMI (2004): A Guide to the Project Management Body of Knowledge • RKW / GPM: Projektmanagement Fachmann • Schelle / Ottmann / Pfeiffer (2005): ProjektManager

Course L1897: Project Management and Agile Methods	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Fachtheoretisch-fachpraktische Arbeit
Examination duration and scale	Ausarbeitung eines Projektplans in Kleingruppen (ca. 5-10 Seiten)
Lecturer	Christian Bussler
Language	DE
Cycle	SoSe
Content	The Seminar teaches the basics of project management, which constitutes the foundations for technical as well as for business projects. It also includes a sideline about process management. The participants will work on the following questions: • What is a project and what challenges does it imply? • What methods have been developed to meet those challenges? • How have this methods evolved over time? What is “state of the art” today? • What basic skills should project members have? • What is the difference between project and process? How can the latter be analyzed? The approaches are not just taught theoretically, but put to use in group work. Through this approach, participants are enabled to work successfully on actual projects - and manage projects later on. As project work is increasingly important in work life, project management is a key skill for job applicants. Main topics of the seminar include: • The “magic triangle” of project objectives • Typical project phases • Key instruments and methods (project structure plan, RACI, Gantt chart) • Project organization and steering • Team communication and collaboration • The agile approach of Scrum • Process levels and cascading • Process improvement With the knowledge and experience from the seminar, participants should be able to acquire a basic certificate in project management with relatively little additional effort. The certification is available through institutions like GPM. Participants already start working on their homework paper in the group work. It comprises 5 to 10 pages and a structure plan for the chosen project, which can be done in Excel for example. Ideally, the members of the work groups write their homework paper together. The expected scale of the paper would increase in this case, yet not proportionally with the number of group members (4 participants would be expected to hand in a paper of 15-20 pages).
Literature	Hans-D. Litke, Ilonka Kunow; Projektmanagement. 3. Auflage 2015 Georg Patzak, Günter Rattay; Projektmanagement: Projekte, Projektpotfolios, Programme und projektorientierte Unternehmen. 6. Auflage 2014 G P M Deutsche Gesellschaft für Projektmanagement; Kompetenzbasiertes Projektmanagement (PM3): Handbuch für die Projektarbeit, Qualifizierung und Zertifizierung auf Basis der IPMA Competence Baseline Version 3.0. 6. Auflage, 2014 Tom DeMarco; Der Termin: Ein Roman über Projektmanagement. 2007 Jeff Sutherland, Ken Schwaber; Der Scrum Guide. Der gültige Leitfaden für Scrum: Die Spielregeln. Ständig aktualisiert, kostenloser Download auf http://www.scrumguides.org/ Jurgen Appello; Management 3.0: Leading Agile Developers, Developing Agile Leaders. 2010

Course L2349: Accounting and Financial Statements	
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	60 min
Lecturer	Prof. Matthias Meyer
Language	DE
Cycle	WiSe/SoSe
Content	
Literature	

Course L1293: Risk Management	
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	60 Minuten
Lecturer	Dr. Meike Schröder
Language	DE
Cycle	WiSe
Content	Risks are inherent in every aspect of business, and the ability of managing risks is one important aspect that differentiates successful business leaders from others. There exist various categories of risk, such as credit, country, market, liquidity, operational, supply chain and reputational. Companies are vulnerable to risks. What makes such risks even more complex and challenging to manage is that the risks are often not within the direct control of the business executive. They can exist outside of the company boundary, and yet the impact to the company can be huge. The awareness and knowledge of how to manage risks in companies, will become increasingly important. Some of the main topics covered in this lecture include: • Targets and legal aspects of risk management • Risks and their impact • Risk types (classification) • Risk management and human resource • Steps of the risk management process and their instruments • Methods of risk assessment • Implementation of risk management • Management of specific risks This lecture is presented in German language only.
Literature	Brühwiler, B., Romeike, F. (2010), Praxisleitfaden Risikomanagement. ISO 31000 und ONR 49000 sicher anwenden, Berlin: Erich Schmidt. Cottin, C., Döhler, S. (2013), Risikoanalyse. Modellierung, Beurteilung und Management von Risiken mit Praxisbeispielen, 2. überarbeitete und erweiterte Aufl., Wiesbaden: Springer. Eller, R., Heinrich, M., Perrot, R., Reif, M. (2010), Kompaktwissen Risikomanagement. Nachschlagen, verstehen und erfolgreich umsetzen, Wiesbaden: Gabler. Fiege, S. (2006), Risikomanagement- und Überwachungssystem nach KonTraG. Prozess, Instrumente, Träger, Wiesbaden: Deutscher Universitäts-Verlag. Frame, D. (2003), Managing Risk in organizations. A guide for managers, San Francisco: Wiley. Götze, U., Henselmann, K., Mikus, B. (2001), Risikomanagement, Heidelberg: Physica-Verlag. Müller, K. (2010), Handbuch Unternehmenssicherheit. Umfassendes Sicherheits-, Kontinuitäts- und Risikomanagement mit System, 2., neu bearbeitete Auflage, Wiesbaden: Springer. Rosenkranz, F., Missler-Behr, M. (2005), Unternehmensrisiken erkennen und managen. Einführung in die quantitative Planung, Berlin u.a.: Springer. Wengert, H., Schittenhelm F. A. (2013), Coporate Risk Mangement, Berlin: Springer.

Course L1389: Key Aspects of Patent Law	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	
Lecturer	Prof. Christian Rohnke
Language	DE
Cycle	SoSe
Content	Mayor Issues in Patent Law: The seminar covers five mayor issues in german patent law, namely patentatbility, prosecution, ownership and employee inventions, infringement and licensing and other commercila uses. The lecturer will give an introduction to each issue which will be followed by in-depth inquiry by the participants through group work, presentation of results and moderated discussion.
Literature	wird noch bekannt gegeben

Course L1491: Startup Engineering	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Fachtheoretisch-fachpraktische Arbeit
Examination duration and scale	Ausarbeitung einer Geschäftsidee auf 20-30 Seiten (Inhaltsfolien zur detailliierten Dokumentation des Herangehensweise). Bearbeitungsdauer über den ganzen Kurs hinweg 13 Wochen, Zwischen- und Abschlusspräsentation jeweils 15 min plus 15 Diskussion.
Lecturer	Prof. Christoph Ihl
Language	EN
Cycle	WiSe
Content	Important note: This course is part of an 6 ECTS module consisting of the three courses "Startup Engineering", "Startup Engineering Project" and "Entrepreneurship Management", which have to be taken together in one semester. Startups are temporary, team-based organizations, which can form both within and outside of established companies, to pursue one central objective: taking a new venture idea to market by designing a business model that can be scaled to a full-grown company. In this course, students will form startup teams around self-selected ideas and run through the process just like real startups would do in the first three months of intensive work. Startup Engineering takes an incremental and iterative approach, in that it favors variety and alternatives over one detailed, linear five-year business plan to reach steady state operations. From a problem solving and systems thinking perspective, student teams create different possible versions of a new venture and alternative hypotheses about value creation for customers and value capture vis-à-vis competitors. To test critical hypotheses early on, student teams engage in an evidence-based, experimental trial-and-error learning process that measures real progress. Upon completion of this course, students will be able to: · Apply a modern innovation toolkit relevant in both the corporate & startup world · Analyze given business opportunities in terms of its constituent elements · Design new business models by gathering and combining relevant ideas, facts and information · Evaluate business opportunities and derive judgment about next steps & decisions Course language is English, but participants can decide to give their graded presentations in German. Students are invited to apply to this course module already with a startup idea and/ or team, but this is not a requirement! We will form teams and ideas in the beginning of the course. Class meetings have alternate intervals of lecture inputs, teamwork, mentoring, and peer feedback. Attendance is mandatory for at least 80% of class time due to large proportion of teamwork sessions. Student teams give three presentations and submit them with backup analyses. Grading scheme: · Startup discovery presentation after 5 weeks: 30% · Startup validation presentation after 10 weeks: 30% · Final startup pitches after 13 weeks: 40%
Literature	• Blank, S. & Dorf, B. (2012). The startup owner's manual. • Gans, J. & Stern, S. (2016). Entrepreneurial Strategy. • Osterwalder, A. & Yves, P. (2010). Business model generation. • Maurya, A. (2012). Running lean: Iterate from plan A to a plan that works. • Maurya, A. (2016). Scaling lean: Mastering the Key Metrics for Startup Growth. • Wilcox, J. (2016). FOCUS Framework: How to Find Product-Market Fit.

Course L1492: Startup Engineering Project	
Typ	Project-/problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	20 min
Lecturer	Prof. Christoph Ihl
Language	EN
Cycle	WiSe
Content	Important note: This course is part of an 6 ECTS module consisting of the three courses "Startup Engineering", "Startup Engineering Project" and "Entrepreneurship Management", which have to be taken together in one semester. Startups are temporary, team-based organizations, which can form both within and outside of established companies, to pursue one central objective: taking a new venture idea to market by designing a business model that can be scaled to a full-grown company. In this course, students will form startup teams around self-selected ideas and run through the process just like real startups would do in the first three months of intensive work. Startup Engineering takes an incremental and iterative approach, in that it favors variety and alternatives over one detailed, linear five-year business plan to reach steady state operations. From a problem solving and systems thinking perspective, student teams create different possible versions of a new venture and alternative hypotheses about value creation for customers and value capture vis-à-vis competitors. To test critical hypotheses early on, student teams engage in an evidence-based, experimental trial-and-error learning process that measures real progress. Upon completion of this course, students will be able to: · Apply a modern innovation toolkit relevant in both the corporate & startup world · Analyze given business opportunities in terms of its constituent elements · Design new business models by gathering and combining relevant ideas, facts and information · Evaluate business opportunities and derive judgment about next steps & decisions Course language is English, but participants can decide to give their graded presentations in German. Students are invited to apply to this course module already with a startup idea and/ or team, but this is not a requirement! We will form teams and ideas in the beginning of the course. Class meetings have alternate intervals of lecture inputs, teamwork, mentoring, and peer feedback. Attendance is mandatory for at least 80% of class time due to large proportion of teamwork sessions. Student teams give three presentations and submit them with backup analyses. Grading scheme: · Startup discovery presentation after 5 weeks: 30% · Startup validation presentation after 10 weeks: 30% · Final startup pitches after 13 weeks: 40%
Literature	• Blank, S. & Dorf, B. (2012). The startup owner's manual. • Gans, J. & Stern, S. (2016). Entrepreneurial Strategy. • Osterwalder, A. & Yves, P. (2010). Business model generation. • Maurya, A. (2012). Running lean: Iterate from plan A to a plan that works. • Maurya, A. (2016). Scaling lean: Mastering the Key Metrics for Startup Growth. • Wilcox, J. (2016). FOCUS Framework: How to Find Product-Market Fit.

Course L2409: Strategic Shared-Value Management	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	30 Minuten
Lecturer	Dr. Jill Küberling-Jost
Language	EN
Cycle	SoSe
Content	
Literature	

Course L2295: Strategische Planung mit Planspielen	
Typ	Project-/problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	
Lecturer	Dr. Jan Spitzner
Language	DE
Cycle	SoSe
Content	
Literature	

Course L2410: Technology Entrepreneurship	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	30 Minuten
Lecturer	Prof. Christoph Ihl
Language	EN
Cycle	SoSe
Content	
Literature	

Course L1351: Management Consulting	
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	
Lecturer	Gerald Schwetje
Language	DE
Cycle	SoSe
Content	The Management Consulting lecture teaches students knowledge that is complementary to their technical and business administration studies. They learn the basics of consulting and agent-principal theory and are given an overview of the consulting market. They are also shown how management consulting works and which methodical building blocks (processes) are needed to deal with a client’s concerns and to undertake a consulting process. By means of practical examples students gain an insight into the extensive range of management consultancy services and of functional consulting.
Literature	Bamberger, Ingolf (Hrsg.): Strategische Unternehmensberatung: Konzeptionen - Prozesse - Methoden, Gabler Verlag, Wiesbaden 2008 Bansbach, Schübel, Brötzel & Partner (Hrsg.): Consulting: Analyse - Konzepte - Gestaltung, Stollfuß Verlag, Bonn 2008 Fink, Dietmar (Hrsg.): Strategische Unternehmensberatung, Vahlens Handbücher, München, Verlag Vahlen, 2009 Heuermann, R./Herrmann, F.: Unternehmensberatung: Anatomie und Perspektiven einer Dienstleistungselite, Fakten und Meinungen für Kunden, Berater und Beobachter der Branche, Verlag Vahlen, München 2003 Kubr, Milan: Management consulting: A guide to the profession, 3. Auflage, Geneva, International Labour Office, 1992 Küting, Karlheinz (Hrsg.): Saarbrücker Handbuch der Betriebswirtschaftlichen Beratung; 4. Aufl., NWB Verlag, Herne 2008 Nagel, Kurt: 200 Strategien, Prinzipien und Systeme für den persönlichen und unternehmerischen Erfolg, 4. Aufl., Landsberg/Lech, mi-Verlag, 1991 Niedereichholz, Christel: Unternehmensberatung: Beratungsmarketing und Auftragsakquisition, Band 1, 2. Aufl., Oldenburg Verlag, 1996 Niedereichholz; Christel: Unternehmensberatung: Auftragsdurchführung und Qualitätssicherung, Band 2, Oldenburg Verlag, 1997 Quiring, Andreas: Rechtshandbuch für Unternehmensberater: Eine praxisorientierte Darstellung der typischen Risiken und der zweckmäßigen Strategien zum Risikomanagement mit Checklisten und Musterverträgen, Vahlen Verlag, München 2005 Schwetje, Gerald: Ihr Weg zur effizienten Unternehmensberatung: Beratungserfolg durch eine qualifizierte Beratungsmethode, NWB Verlag, Herne 2013 Schwetje, Gerald: Wer seine Nachfolge nicht regelt, vermindert seinen Unternehmenswert, in: NWB, Betriebswirtschaftliche Beratung, 03/2011 und: Sparkassen Firmenberatung aktuell, 05/2011 Schwetje, Gerald: Strategie-Assessment mit Hilfe von Arbeitshilfen der NWB-Datenbank - Pragmatischer Beratungsansatz speziell für KMU: NWB, Betriebswirtschaftliche Beratung, 10/2011 Schwetje, Gerald: Strategie-Werkzeugkasten für kleine Unternehmen, Fachbeiträge, Excel-Berechnungsprogramme, Checklisten/Muster und Mandanten-Merkblatt: NWB, Downloadprodukte, 11/2011 Schwetje, Gerald: Die Unternehmensberatung als komplementäres Leistungsangebot der Steuerberatung - Zusätzliches Honorar bei bestehenden Klienten: NWB, Betriebswirtschaftliche Beratung, 02/2012 Schwetje, Gerald: Die Mandanten-Berater-Beziehung: Erfolgsfaktor Beziehungsmanagement, in: NWB Betriebswirtschaftliche Beratung, 08/2012 Schwetje, Gerald: Die Mandanten-Berater-Beziehung: Erfolgsfaktor Vertrauen, in: NWB Betriebswirtschaftliche Beratung, 09/2012 Wohlgemuth, Andre C.: Unternehmensberatung (Management Consulting): Dokumentation zur Vorlesung „Unternehmensberatung“, vdf Hochschulverlag, Zürich 2010

Course L0536: Management of Trust and Reputation	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	20-30 Minuten und Thesenpapier
Lecturer	Dr. Michael Florian
Language	DE
Cycle	SoSe
Content	The seminar offers a comparison and analysis of relevant theoretical concepts and practical issues in the corporate management of trust and reputation. Selected case studies will be used to discuss opportunities, problems, and limitations using trust and reputation to coordinate and control economic behavior.
Literature	Allgäuer, Jörg E. (2009): Vertrauensmanagement: Kontrolle ist gut, Vertrauen ist besser. Ein Plädoyer für Vertrauensmanagement als zentrale Aufgabe integrierter Unternehmenskommunikation von Dienstleistungsunternehmen. München: brain script Behr. Beckert, Jens; Metzner, André; Roehl, Heiko (1998): Vertrauenserosion als organisatorische Gefahr und wie ihr zu begegnen ist. In: Organisationsentwicklung 17 (4), S. 57-66. Eberl, Peter (2003): Vertrauen und Management. Studien zu einer theoretischen Fundierung des Vertrauenskonstruktes in der Managementlehre. Stuttgart: Schäffer-Poeschel. Eberl, Peter (2012): Vertrauen und Kontrolle in Organisationen. Das problematische Verhältnis der Betriebswirtschaftslehre zum Vertrauen. In: Möller, Heidi (Hg.): Vertrauen in Organisationen. Riskante Vorleistung oder hoffnungsvolle Erwartung? Wiesbaden: Springer VS, S. 93-110. Eisenegger, Mark (2005): Reputation in der Mediengesellschaft. Konstitution Issues Monitoring Issues Management. Wiesbaden: VS Verlag für Sozialwissenschaften. Florian, Michael (2013): Paradoxien des Vertrauensmanagements. Risiken und Chancen einer widerspenstigen immateriellen Ressource. In: Personalführung 46, Heft 2/2013, S. 40-47. Grüninger, Stephan (2001): Vertrauensmanagement - Kooperation, Moral und Governance. Marburg: Metropolis. Grüninger, Stephan; John, Dieter (2004): Corporate Governance und Vertrauensmanagement. In: Josef Wieland (Hg.): Handbuch Wertemanagement. Erfolgsstrategien einer modernen Corporate Governance. Hamburg: Murmann, S. 149-177. Meifert, Matthias (2008): Ist Vertrauenskultur machbar? Vorbedingungen und Überforderungen betrieblicher Personalpolitik. In: Rainer Benthin und Ulrich Brinkmann (Hg.): Unternehmenskultur und Mitbestimmung. Betriebliche Integration zwischen Konsens und Konflikt. Frankfurt/Main, New York: Campus, S. 309-327. Neujahr, Elke; Merten, Klaus (2012): Reputationsmanagement. Zur Kommunikation von Wertschätzung. In: PR-Magazin 06/2012, S. 60-67. Osterloh, Margit; Weibel, Antoinette (2006): Investition Vertrauen. Prozesse der Vertrauensentwicklung in Organisationen. Wiesbaden: Gabler. Osterloh, Margit; Weibel, Antoinette (2006): Vertrauen und Kontrolle. In: Robert J. Zaugg und Norbert Thom (Hg.): Handbuch Kompetenzmanagement. Durch Kompetenz nachhaltig Werte schaffen. Festschrift für Prof. Dr. Dr. h.c. mult. Norbert Thom zum 60. Geburtstag. Bern [u.a.]: Haupt, S. 53-63. Osterloh, Margit; Weibel, Antoinette (2007): Vertrauensmanagement in Unternehmen: Grundlagen und Fallbeispiele. In: Manfred Piwinger und Ansgar Zerfaß (Hg.): Handbuch Unternehmenskommunikation. Wiesbaden: Gabler, S. 189-203. Schmidt, Matthias; Beschorner, Thomas (2005): Werte- und Reputationsmanagement. München und Mering: Hampp. Seifert, Matthias (2003): Vertrauensmanagement in Unternehmen. Eine empirische Studie über Vertrauen zwischen Angestellten und ihren Führungskräften. 2. Aufl. München und Mering: Hampp. Sprenger, Reinhard K. (2002): Vertrauen führt. Worauf es im Unternehmen wirklich ankommt, Frankfurt/Main, New York. Thiessen, Ansgar (2011): Organisationskommunikation in Krisen. Reputationsmanagement durch strategische, integrierte und situative Krisenkommunikation. Wiesbaden: VS Verlag für Sozialwissenschaften. Walgenbach, Peter (2000): Das Konzept der Vertrauensorganisation. Eine theoriegeleitete Betrachtung. In: Die Betriebswirtschaft 60 (6), S. 707-720. Walgenbach, Peter (2006): Wieso ist Vertrauen in ökonomischen Transaktionsbeziehungen so wichtig, und wie lässt es sich generieren? In: Hans H. Bauer, Marcus M. Neumann und Anja Schüle (Hg.): Konsumentenvertrauen. Konzepte und Anwendungen für ein nachhaltiges Kundenbindungsmanagement. München: Vahlen, S. 17-26. Weibel, Antoinette (2004): Kooperation in strategischen Wissensnetzwerken. Vertrauen und Kontrolle zur Lösung des sozialen Dilemmas. Wiesbaden: Dt. Univ.-Verl. Weinreich. Uwe (2003): Vertrauensmanagement. In: Deutscher Manager-Verband e.V. (Hg.): Die Zukunft des Managements. Perspektiven für die Unternehmensführung. Zürich: Vdf, Hochsch.-Verl. an der ETH, S. 193-201.

Course L1381: Public and Constitutional Law	
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	2 Stunden
Lecturer	Klaus-Ulrich Tempke
Language	DE
Cycle	WiSe/SoSe
Content	Different areas of public law; proceedings, jurisdiction of administrative courts with stages of appeal, members of the courts; Court levels, organization and legal capacity; Introduction to and structure of fundamental rights; Human dignity: the guiding principle of the constitution; General right of privacy and freedom of action.
Literature	

Module M0524: Non-technical Courses for Master

Module Responsible	Dagmar Richter
Admission Requirements	None
Recommended Previous Knowledge	None
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	**The Nontechnical Academic Programms (NTA)** 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 **teaching architecture**, in its **teaching and learning arrangements**, in **teaching areas** and by means of teaching offerings in which students can qualify by opting for **specific competences** and a **competence level** at the Bachelor's or Master's level. The teaching offerings are pooled in two different catalogues for nontechnical complementary courses. **The Learning Architecture** consists of a cross-disciplinarily study offering. The centrally designed teaching offering ensures that courses in the nontechnical academic programms follow the specific profiling of TUHH degree courses. 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". 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. **Teaching and Learning Arrangements** 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. **Fields of Teaching** are based on research findings from the academic disciplines cultural studies, social studies, arts, historical studies, communication studies, migration 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. 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. **The Competence Level** 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. 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. **Specialized Competence (Knowledge)** Students can • explain specialized areas in context of the relevant non-technical disciplines, • outline basic theories, categories, terminology, models, concepts or artistic techniques in the disciplines represented in the learning area, • different specialist disciplines relate to their own discipline and differentiate it as well as make connections, • 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, • Can communicate in a foreign language in a manner appropriate to the subject.
Skills	**Professional Competence (Skills)** In selected sub-areas students can • apply basic and specific methods of the said scientific disciplines, • aquestion a specific technical phenomena, models, theories from the viewpoint of another, aforementioned specialist discipline, • to handle simple and advanced questions in aforementioned scientific disciplines in a sucsessful manner, • justify their decisions on forms of organization and application in practical questions in contexts that go beyond the technical relationship to the subject.
Personal Competence	
Social Competence	**Personal Competences (Social Skills)**

	Students will be able • to learn to collaborate in different manner, • to present and analyze problems in the abovementioned fields in a partner or group situation in a manner appropriate to the addressees, • to express themselves competently, in a culturally appropriate and gender-sensitive manner in the language of the country (as far as this study-focus would be chosen), • to explain nontechnical items to auditorium with technical background knowledge.
Autonomy	**Personal Competences (Self-reliance)** Students are able in selected areas • to reflect on their own profession and professionalism in the context of real-life fields of application • to organize themselves and their own learning processes • to reflect and decide questions in front of a broad education background • to communicate a nontechnical item in a competent way in writen form or verbaly • to organize themselves as an entrepreneurial subject country (as far as this study-focus would be chosen)
Workload in Hours	Depends on choice of courses
Credit points	6

Course L1775: “What’s up, Doc?” Science and Stereotypes in Literature and Film	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	etwa 20 Minuten Präsentation und 10-20 Minuten Diskussion
Lecturer	Dr. Jennifer Henke
Language	EN
Cycle	WiSe/SoSe
Content	Popular novels and films significantly contribute to the public understanding of science and its representatives. How to define “good” or “bad” science is negotiated in a variety of artistic works. Stereotypes such as the “mad scientist”, which originated in early nineteenth century England, continue to persist. Mary Shelley created the prototype of the obsessive and reckless scientist in Frankenstein - The Modern Prometheus (1818) who conducts his forbidden experiments in a secret lab and crosses ethical boundaries. This masculine stereotype has been followed by further ones such as the noble, adventurous or clumsy scientist, whereas scholars have only recently begun to consider the representation of female science. First, this seminar is devoted to selected formations of knowledge in relation to literature from classical antiquity to the present. Second, the focus shall rest on the production of persistent stereotypes in various media formats such as novels or films while paying particular attention to the aspect of gender. The overall goal of the seminar is an understanding of science as a cultural practice. Requirements for participation: Shelley, Mary: Frankenstein. New York: Norton, 2012. Please pay attention to the exact publication dates.
Literature	Teilnahmevoraussetzungen: Shelley, Mary: Frankenstein. New York: Norton, 2012. Bitte ausschließlich diese Edition anschaffen.

Course L2064: 120 years of film history	
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 min
Lecturer	Prof. Margarete Jarchow
Language	DE
Cycle	SoSe
Content	The lecture deals with the relationship between the develpoment of film technology, film aesthetics, and society. Based on the nineteenth-century film's precursors such as the laterna magica, photography and kinetoscope, crucial stages of more than 120 years of film history are studied chronologically in terms of: How does the development of new media techniques reflect certain social changes and needs? What new forms of aesthetic expression are possible through such technical innovations as the introduction of sound film, color film or handheld camera? And to what extent do these new forms of aesthetic expression in turn reflect certain social sensitivities, ultimately the respective zeitgeist? Main topics of the lecture are: the technical euphoria of the 19th century, the early film, the German Expressionist film, the classic Hollywood cinema, the European postwar cinema, exploitation and underground cinema, New Hollywood, the blockbuster cinema, independent cinema up to current phenomena like the „cinema of dissolution“. On the one hand, the participants learn in-depth, detailed knowledge of the history, meaning and analysis of the medium film and thereby acquire media literacy. On the other hand, the participants should gain a deeper understanding of the real interdependencies of technologies in culture and society and their historical transformation processes through an interdisciplinary perspective on film (history of technology, media studies and social science).
Literature	

Course L1774: Applied Arts: Form and Function	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	etwa 20 Minuten Präsentation und 10-20 Minuten Diskussion
Lecturer	Prof. Margarete Jarchow, Dr. Christian Lechelt
Language	DE
Cycle	WiSe/SoSe
Content	From Arts & Crafts to modern Design - applied arts focus on the design of all kinds of products. Therefore applied arts allow to come to more thorough conclusions about social, historical, cultural issues. In the course the impact of social developments on these particular genres are discussed.
Literature	Wird noch angegeben Will be announced in lecture

Course L2338: Bauhaus architecture - a search for traces	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	etwa 20 Minuten Präsentation und 10-20 Minuten Diskussion
Lecturer	Dr. Jörg Schilling
Language	DE
Cycle	WiSe/SoSe
Content	The „100 years of bauhaus“ centenery also involved examining the references, differences and similarities to Hamburg architecture from 1919-1933. The seminar intends to find these traces in social (i.e. Jarrestadt) and private (i.e. Landhaus Michaelsen / Puppenmuseum) housing as well as in numerous other building projects. During the excursions to buildings by Hamburg architects like Fritz Schumacher, Gustav Oelsner, Karl Schneider and others we will discuss aspects related to architectural modernism.
Literature	wird im Seminar bekanntgegeben

Course L1882: Facilitating groups in problem-oriented courses	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Fachtheoretisch-fachpraktische Arbeit
Examination duration and scale	Schriftliche Ausarbeitung (in mehreren Teilen) sowie eine Präsentation, Teilnahme an Gruppendiskussionen
Lecturer	Siska Simon
Language	DE
Cycle	WiSe/SoSe
Content	Content: - Changing the role of the teacher in problem-oriented courses - Structure and benefits of problem-oriented courses - Attitude and beliefs concerning teaching and learning - Question and discussion techniques - Group dynamic processes - Situation-related interventions - dealing with heterogeneous groups - Moderation and presentation - Interference levels and conflict management - Feedback processes and methods Methods: - impulse lectures and group work - Planning, execution and reflection of an exemplary course unit - Micro teaching and feedback - peer observation and feedback
Literature	Auszüge aus Fachliteratur zu oben genannten Themen werden in der Veranstaltung ausgegeben

Course L1990: Clash of Cultures. Film and TV series as images of the own and the other	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	etwa 20 Minuten Präsentation und 10-20 Minuten Diskussion
Lecturer	Jacobus Bracker
Language	DE
Cycle	WiSe/SoSe
Content	Images are negotiating concepts of the own, other and alien. Especially tv series like “Game of Thrones”, “Vikings”, or “The Walking Dead” and films like “Alien” or “Lord of the Rings” show clashes of cultures. Irrespective of their genre - fantasy, science fiction, or history - the moving images use always similar patterns to show and tell the own and the other. During the seminar we will deal with such concepts and concepts of culture and the specifics of film and series to watch and analyse selected examples from these perspectives.
Literature	Literaturhinweise, Texte etc. werden zu gegebener Zeit online zur Verfügung gestellt.

Course L1176: The end is near - Survival in the post-apocalypse	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	etwa 20 Minuten Präsentation und 10-20 Minuten Diskussion
Lecturer	Dr. Marlis Bussacker
Language	DE
Cycle	WiSe/SoSe
Content	According to the FAZ in December 2015, the end of the world is booming. At all times, people have dealt with the imminent future scenario of ultimate horror - the collapse of their own world. Where does the idea of a final disaster come from? What's so fascinating about our own demise? During the seminar we will take a look at European cultural history, which is closely linked to mythological and religious prophecies about the end of the world. However, this question, or rather the question of survival in a post-apocalyptic world, has fortunately remained speculative to this day despite regular predictions. Since the end of the world has not yet happened in reality, we are therefore dependent on the imagination of writers, screenwriters and directors who have anticipated the event in an infinite number of texts, films and series. Based on selected films and texts, the seminar will focus on the questions of which apocalyptic scenarios are developed, with which problems the survivors are confronted and how they deal with the situation and with each other. The focus is on the reactions of people in a state of extreme threat. Which survival strategies are presented to us, how do we assess the behaviour of the actors, can we create alternatives? Furthermore, the effect of the genre on the recipient will be discussed. Do we dismiss films like Armaggedon and The Day After Tomorrow as entertaining thrills? Do we just enjoy the special effects? Do we feel threatened? Do we take them in the end as real instructions for action? Do they make us reflect? Or are even current social discourses reflected in the garment of the apocalypse?
Literature	

Course L1441: German as a Foreign Language for International Master Programs	
Typ	Seminar
Hrs/wk	4
CP	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Examination Form	Klausur
Examination duration and scale	
Lecturer	Dagmar Richter
Language	DE
Cycle	WiSe/SoSe
Content	Master’s German course in cooperation with IBH e.V. - Master’s German courses at different levels In the international studies program these are obligatory for non-native speakers of German and for students without a DSH certificate or equivalent TEST-DAF result. Grading after an aptitude test. All other students must sign up for a total of 4 ECTS from the catalog of non-technical supplementary courses.
Literature	- Will be announced in lectures -

Course L1884: The Hamburger Speicherstadt - from achievements of engineering to world cultural heritage	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	20 minütiges Referat mit anschließender Diskussion
Lecturer	Dr. Jörg Schilling
Language	DE
Cycle	WiSe/SoSe
Content	The seminar wants to show the problems and challenges for the engineers, who built the Hamburger Speicherstadt and their sustainable architectural solutions, which are still of vital importance and the basis for becoming a world cultural heritage.
Literature	u.a.: Hamburg und seine Bauten unter Berücksichtigung seiner Nachbarstädte Altona und Wandsbek, hg. vom Architekten- und Ingenieur-Verein zu Hamburg, Hamburg 1890; Karin Maak: Die Speicherstadt im Hamburger Hafen, Hamburg 1895; Hermann Hipp: Freie und Hansestadt Hamburg, Köln 1989; Matthias von Popowski: Franz Andreas Meyer (1837-1901). Oberingenieur und Leiter des Ingenieurwesens von 1872-1901, in: Wie das Kunstwerk Hamburg entstand, hg. v. Dieter Schädel, Hamburg 2006, S. 64-79; Ralf Lange: HafenCity + Speicherstadt : das maritime Quartier in Hamburg, Hamburg 2010.

Course L1996: Digital culture(s): from subculture to media mainstream	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	etwa 20 Minuten Präsentation und 10-20 Minuten Diskussion
Lecturer	Dr. Oliver Schmidt
Language	DE
Cycle	WiSe/SoSe
Content	The course gives an introduction to the development of digitization in a media cultural perspective. In addition to technical aspects, we will focus on the cultural impact of digitization for current media users and the ermergence und development of media subcultures from the late 1970s to the 21st century. On the one hand, we will deal with questions such as: What is digitization? What is culture? What are digital (sub)cultures? In this context, the concept of ‚digital natives‘ and ‚digital immigrants‘, coined by Marc Prensky, will also be discussed. On the other hand, there will be a historical perspective on topics and developments such as the mediatization oft he children’s room in the early 1980s, the hacker scene, video game culture, the demo scene, digital culture in cinema, 8-bit culture, digital aesthetics , net art, post-digitality and ultimately the question of how digital subcultures have become part of the media mainstream at the beginning of the 21st century.
Literature	

Course L2367: Digital art	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	Referat ca. 20 min. plus anschließende Diskussion
Lecturer	Dr. Imke Hofmeister
Language	DE
Cycle	WiSe/SoSe
Content	Digitalization is having a major impact on many areas of our lives and the use of digital technologies in art and design has increased rapidly. After all, art is not only subject to constant change, but also constantly adapts to technical conditions. After the photographic art of the mid-19th century and the video art of the 1960s, which already brought about major changes in artistic creation, digital art is becoming increasingly important in the field of media art. The first attempts to use the computer with corresponding graphic software as an artistic medium took place in the 80/90s of the 20th century. Since then, there has been a broad development in the field of digital art, which now encompasses the most diverse digital pictorial phenomena and art genres and is thus intertwined in its objects, theories and practices with digital media in a variety of ways. The seminar gives an overview of the history of digital art and its different genres. These include, for example, photopaintings, where digital manipulation, filtering processes and painting can process the image and transform it over many stages into a completely new form. Also 3-D images, vector graphics, mathematical art and computer art in general. At the same time, the digital development in art is to be illuminated, from the first beginnings on the computer with comparatively simple "digital aids", e.g. in the form of simple image processing programs, to the present sophisticated graphic tools. In addition, the presentation, dissemination and conservation possibilities of digital art will also be discussed, which can be disseminated very well on the Internet primarily because it can be displayed on a computer screen. The great fascination with digital creative work and the almost inexhaustible possibilities offered by the medium of computers to artists, who will continue to ensure that digital art finds a permanent place alongside traditional media, will also be discussed. Finally, in contrast to the traditional production methods in the field of fine arts and design, there are always new manifestations of digital art, which ultimately give not only the "trained" artist but also the layman far-reaching possibilities for artistic expression. And all this in the spirit of the performance artist Joseph Beuys , who postulated, every human being is capable of creativity, indeed "every human being is an artist". The seminar will also discuss the question of how digital art can be described as "the" contemporary art, i.e. contemporary art in the age of digital technology. Furthermore, it is of great interest to what extent the perception of art per se has already changed and will continue to change in a digitalized society.
Literature	folgt

Course L1725: Introduction to the Science & Technoloy Studies (STS)	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	Gruppenreferat (30 bis 45 Minuten, Eigenanteil je Person 10 bis 15 Minuten) inkl. schriftlicher Ausarbeitung, Ggf. alternativ eine längere, schriftliche Ausarbeitung.
Lecturer	Dr. Simon Egbert
Language	EN
Cycle	WiSe/SoSe
Content	Since the end of the 1980’s or the beginning of the 1990’s, in the Sociology of Technology a line of research has emerged which initially called for a socialization of the sociology of technology (especially through the Social Construction of Technology Approach [SCOT]) and right away called for its re-materialisation (especially through Bruno Latour and the Actor-Network Theory). Technologies, thus their basic idea, are always intertwined with society and shaped by their socio-cultural context. In reverse, society is also inherently formed by the existing technologies and an adequate sociology of technology has to deal especially with the interaction of both. In the seminar at hand first of all an overview shall be given about the classical sociology of technology which routinely used argumentations inspired by technological determinism, which shall be followed by the presentation of the SCOT-approach. The later in turn was criticised by the Actor-Network Theory (which will be presented in a separate section as well) as being social deterministic which has led to a rather heated debate about the agency of technological artefacts, which shall be presented and discussed in a further part of the seminar. In the last section of the class it shall be determined what kind of relevance the sociological analysis of technological artefacts and their societal embedding can or could implicate for the own lifeworld of the students - especially of course with special focus on their engineer studies.
Literature	Bammé, Arno (2009): Science and Technology Studies: ein Überblick. Marburg: Metropolis. Degele, Nina (2002): Einführung in die Techniksoziologie. München: Fink. Hackett, Edward et al. (Hrsg.) (2008): The Handbook of Science and Technology Studies. 3 rd Edition. Cambridge: MIT Press. Häußling, Roger (2014): Techniksoziologie. Baden-Baden: Nomos. MacKenzie, Donald/Judy, Wajcman (2003): The social shaping of technology. 2 nd Edition. Maidenhead et al.: Open University Press. Sismondo, Sergio (2010): An Introduction to Science and Technology Studies, 2 nd Edition. Chichester: Wiley-Blackwell.

Course L2336: Introduction to Marxian Theory of Economy	
Typ	Seminar
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 min
Lecturer	Dr. Martin Schütz
Language	DE
Cycle	WiSe/SoSe
Content	Capitalism - what’s the definition in Marxian economical theorie? Which are the functions of gold, money, interest? Focusing on the Marxian basis categories Ware - Gebrauchswert - Tauschwert - Wert - Arbeit - Austauschprozess - Geld - Zirkulation - Arbeitskraft, the subjects of the lecture are the first four chapters of ‘Das Kapital’ vol. 1, accompanied by discussion of neo-classical theory, monetarism etc.
Literature	Karl Marx, Das Kapital, Band 1, Berlin 1962ff (=Marx-Engels-Werke [MEW] Bd. 23), S. 1-390 Dieser Text steht text- und seitengenau im Internet zur Verfügung: http://www.mlwerke.de/me/me23/me23_000.htm oder http://www.zeno.org/Philosophie/M/Marx,+Karl/Das+Kapital David Harvey, Marx‘ Kapital lesen, Hamburg 2017, Seiten 1-214 Begleitend: Harvey selbst hat seine ‚Kapital‘-Seminare (auf Englisch) als Stream veröffentlicht: http://davidharvey.org/reading-capital/ Ergänzende Literatur: Altvater, Elmar (Hg.) (1999): Kapital.doc. Das Kapital (Bd. 1) von Marx in Schaubildern mit Kommentaren. Mit CD-ROM. Münster Artus, Ingrid u.a. (Hg.) (2014): Marx für SozialwissenschaftlerInnen. Eine Einführung. Wiesbaden Fülberth, Georg (2008): G Strich. Kleine Geschichte des Kapitalismus. 4., verb. und erw. Aufl. Köln Krause, Alexandra (2014): Kritik der Politischen Ökonomie - Wachstum als Imperativ kapitalistischen Wirtschaftens. In: Artus (2014) S. 135-160. Münch, Richard (2008): Soziologische Theorie. Grundlegung durch die Klassiker. Korr. Nachdr. 2008. Frankfurt/Main (Soziologische Theorie, 1). Nachtwey, Oliver (2014): Arbeit, Lohnarbeit und Industriearbeit. In: Artus (2014) S. 109-134 Söllner, Fritz (2015): Die Geschichte des ökonomischen Denkens. 4. Aufl. Berlin

Course L1994: Facts, Facts, Facts - Understanding and Applying Techniques of Journalism - in German	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	etwa 20 Minuten Präsentation und 10-20 Minuten Diskussion
Lecturer	Prof. Margarete Jarchow, Matthias Kowalski
Language	DE
Cycle	WiSe/SoSe
Content	Regardless of whether it is via classic channels such as newspapers and magazines or radio and TV as well as via internet, social media or via communication in specialist circles: Today we encounter journalism in almost all forms of public and private communication. But what makes a story really important in this flood of content? How do we recognize relevance? How do we expose fake news? In this block seminar the principles of journalistic techniques are imparted by means of practical examples and editorial exercises. The participants also develop tools to detect and deactivate manipulation and fake news. Regular attendance and attendance at all block dates is required.
Literature	

Course L2370: Facts, Facts, Facts - Understanding and Applying Techniques of Journalism - in English	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	etwa 20 Minuten Präsentation und 10-20 Minuten Diskussion
Lecturer	Prof. Margarete Jarchow
Language	EN
Cycle	WiSe/SoSe
Content	Regardless of whether it is via classic channels such as newspapers and magazines or radio and TV as well as via internet, social media or via communication in specialist circles: Today we encounter journalism in almost all forms of public and private communication. But what makes a story really important in this flood of content? How do we recognize relevance? How do we expose fake news? In this block seminar the principles of journalistic techniques are imparted by means of practical examples and editorial exercises. The participants also develop tools to detect and deactivate manipulation and fake news. Regular attendance and attendance at all block dates is required.
Literature	folgt

Course L0970: Foreign Language Course	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and scale	60 min
Lecturer	Dagmar Richter
Language	
Cycle	WiSe/SoSe
Content	In the Field of the Nontechnical Complementary Courses students are able to chose foreign language courses. Therefore the Hamburger Volkshochschule offers a special language programm on TUHH campus for TUHH Students. It includes courses in english, chinese, french, japanese, portuguese, russia, swedish, spanisch and german as a foreign language. All lectures impart common language knowledge, english courses although english for technical purposes.
Literature	Kursspezifische Literatur / selected bibliography depending on special lecture programm.

Course L0983: Management and Communication	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	90-minütige interaktive Präsentation im Team inkl. Handout.
Lecturer	Wibke Derboven
Language	DE
Cycle	SoSe
Content	The seminar will present basic elements of personality-promoting work organisation, motivation theories, different management concepts, communication theories and approaches to conflict and knowledge management. These subjects are applied to specific practical examples. Participants are given the opportunity to reflect on their own communicative and social behaviour.
Literature	Große Boes, Stefanie; Kaseric, Tanja (2010): Trainer-Kit. Die wichtigsten Trainings-Theorien, ihre Anwendung im Seminar und Übungen für den Praxistransfer. 4. Aufl. Bonn: managerSeminare Verlags GmbH Klutmann, Beate (2004): Führung: Theorie und Praxis. Hamburg: Windmühle Laufer, Hartmut (2011): Grundlagen erfolgreicher Mitarbeiterführung. Führungspersönlichkeit, Führungsmethoden, Führungsinstrumente. 11. Auflage. Offenbach: GABAL Neuberger, Oswald (2002): Führen und führen lassen. 6. überarb. und erw. Aufl. Stuttgart: Lucius und Lucius Schulz von Thun, Friedemann; Ruppel, Johannes; Stratmann, Roswitha (2002): Miteinander reden: Kommunikationspsychologie für Führungskräfte. 4. Aufl. Reinbek bei Hamburg

Course L1883: Guest, barbarian or subject with equal rights? ‘The refugee’ in the history of ‘Western’ political ideas.	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	5-10 Minuten Vortrag im Rahmen eines Gruppenreferats; anschließend Diskussion
Lecturer	Dr. Simone Beate Borgstede
Language	DE/EN
Cycle	WiSe/SoSe
Content	The seminar discusses concepts of ‘the refugee’ in the history of ‘Western’ political ideas over a period of about 2,750 years. We will try to understand these concepts as historically distinct. We will also analyze the powerful effect of related stereotypes and images. We will read and contextualize philosophical, sociological, juridical, literary and political texts. In the second part of the seminar we will use the patterns we found to understand actual discourses on flight and migration. One aim is also to recognize alternative representations in the articulations and practices of the refugees themselves.
Literature	Agamben, Giorgio, ‚Homo Sacer: Die souveräne Macht und das nackte Leben.’ Arendt, Hannah, ‚Wir Flüchtlinge’ und ‚Das Recht, Rechte zu haben’. Aristoteles, Politik und Platon, Politeia (Auszüge). Derrida, Jacques, ‚Weltbürger aller Länder, noch eine Anstrengung!’ Erpenbeck, Jenny: Gehen, ging, gegangen. Roman. Genfer Konvention und Menschenrechtserklärung. Homer, Die Odyssee. Simmel, Georg, ‚Exkurs über den Fremden’. Dazu kommen Textstellen aus Bibel und Koran, aktuelle Interviews mit Migrationsforscher_innen wie Manuela Bojadzijev und Vassilis Tsianos, aber auch Erklärungen von Geflüchteten-Gruppen, Musiktexte, Fotographien und Filmspots.

Course L1844: Stay cool in conflict. Nonviolent Communication by Marshall Rosenberg	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	2-3 Seiten bzw. 10-20 Minuten plus anschließende Besprechung
Lecturer	Dr. Claudia Wunram
Language	EN
Cycle	WiSe/SoSe
Content	„Words can build bridges or create rafts“ - this is also true for the scientific and business world. For example, how do I react if I get attacked in a professional debate by an opponent or by a colleague in my team, or if a fight arises during the planning of a project? In a challenging situation, what will help me to communicate respectfully and with appreciation? How can I express criticism or irritation honestly, directly and without reproach? Nonviolent Communication is a concept developped by Marshall B. Rosenberg, Ph.D., intended to help create an appreciative attitude towards oneself and others, and to live by it. Nonviolent Communication opens paths to express oneself in a mindful and responsible way, so that a bridge can be built even in challenging situations of conflict. Effective and satisfactory cooperation is only possible with well functioning communication between all parties involved, otherwise things will become difficult and inefficient. By working with their own examples and anticipating questions that might arise in their future professional lives, the students of Engineering Sciences will be able to reflect their own communicative behavior and learn ways of cooperation and conjoint solution finding. This course will impart the essential competencies of communication necesary for that.
Literature	German: • Rosenberg, Marshall. (2001) Gewaltfreie Kommunikation. Eine Sprache des Lebens. Junfermann • Rosenberg, Marshall B. und Seils, Gabriele. (15. Auflage 2012) Konflikte lösen durch Gewaltfreie Kommunikation. Ein Gespräch mit Gabriele Seils. Herder Taschenbuch • Larsson, Liv. (2013) 42 Schlüsselunterscheidungen in der GFK. Für ein tieferes Verständnis der Gewaltfreien Kommunikation. Junfermann • De Haen, Nayoma V. und Torsten Hardieß. (2015) 30 Minuten Gewaltfreie Kommunikation. Gabal • Connor, Jane M. und Killian, Dian, Drs. (2014) Verbindung herstellen - Trennendes überbrücken. Mit jedermann, jederzeit und überall eine gemeinsame Ebene finden. Praktische GFK für den Alltag. Junfermann • Dietz, Angela. (2015) Macht ohne Machtwort. Verantwortung übernehmen, Potenziale entfalten. Business Village • Miyashiro, Marie R. (2013) Der Faktor Empathie. Ein Wettbewerbsvorteil für Teams und Organisationen. Junfermann • Brüggemeier, Beate. (2010) Wertschätzende Kommunikation im Business. Wer sich öffnet, kommt weiter. Wie Sie die GFK im Berufsalltag nutzen. Junfermann • Heim, Vera und Lindemann, Gabriele. (2016) Beziehungskompetenz im Beruf. Brücken bauen mit Empathie und Gewaltfreier Kommunikation. Haufe Taschen Guide English: • Rosenberg, Marshall B., Ph.D. (3rd Edition 2015) Nonviolent Communication: A Language of Life. Create your Life, your Relationships, and your World in Harmony with your Values. Puddledancer Press • Connor, Jane, Ph.D. and Killian, Dian, Ph.D. (2nd edition 2012) Connecting Across Differences: Finding Common Ground with Anyone, Anywhere, Anytime. Puddledancer Press • Miyashiro, Marie R. (2011) The Empathy Factor. Your Competitive Advantage for Personal, Team and Business Success. Puddledancer Press • Roele, Hugo and Rich-Tolsma, Matthew, Drs. (2015) The Book of Needs. A Structural Model for Listening. Kommunikasie.nl • Kashtan, Miki. (2014) Reweaving our Human Fabric. Working Together to Create a Nonviolent Future. Fearless Heart Publications

Course L2345: Theory, Research and Practice of University Teaching	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Fachtheoretisch-fachpraktische Arbeit
Examination duration and scale	Schriftliche Ausarbeitung (in mehreren Teilen) sowie eine Präsentation
Lecturer	Prof. Christian Kautz, Jenny Alice Rohde
Language	DE
Cycle	WiSe/SoSe
Content	This course covers theory and practice of being a student teaching assistant in small-group instructional settings at TUHH. As part of the seminar, the participants have the opportunity to reflect on their work, e. g. through mutual observation and discussion. For prior knowledge / the event requirements: This event requires basic first work / collaboration experiences in the academic work structures of a higher education institution, which Master's students have acquired as part of the qualification for the Bachelor's degree at a university.

	These presumed work experiences include specific self-study experiences at a college. These are picked up, reflected, expanded and further developed both theoretically and practically with regard to learning from and in groups and later guiding this learning process. Furthermore, experiences with different types of learning / group types of higher education, which are part of a degree program acquired during the bachelor's program, are assumed, taken up, reflected on, expanded and further developed here in the master's program. The course also requires basic knowledge of presenting scholarly work results obtained by Master's students with a Bachelor's degree. In the course, this experience with and in representation in a group situation will be expanded and further developed in the direction of students' involvement with their own role as well as their design in face-to-face interaction as well as in group processes, learning and leadership situations, as masters graduates Graduate unlike bachelor graduates professionally stronger in a moderating role and with the guidance of humans because with the guidance in subject matters are demanded. According to the later professional role, the work of the seminar promotes and enables graduate students significantly more than graduates' qualifications for independent work and learning, transferring what they have learned to new areas, contributing, involving discussion and contributing their own examples and interests.
Literature	**Auszüge aus Fachliteratur zu oben genannten Themen werden in der Veranstaltung ausgegeben.** Bandura, A. (1997). Self-efficacy: The exercise of control. New York: Freeman. Bosse, E. (2016). Herausforderungen und Unterstützung für gelingendes Studieren: Studienanforderungen und Angebote für den Studieneinstieg. In I. van den Berk, K. Petersen, K. Schultes, & K. Stolz (Hrsg.). Studierfähigkeit - theoretische Erkenntnisse, empirische Befunde und praktische Perspektiven (Bd. 15). (S.129-169). Hamburg: Universität Hamburg. Collins, D. & Holton, E. (2004). The effectiveness of managerial leadership development programs: A meta-analysis of studies from 1982 to 2001. Human resource development quarterly, 15(2), 217 - 248. Danielsiek, H., Hubwieser, P., Krugel, J., Magenheim, J., Ohrndorf, L., Ossenschmidt, D., Schaper, N. & Vahrenhold, J. (2017). Verbundprojekt KETTI: Kompetenzerwerb von Tutorinnen und Tutoren in der Informatik. In A. Hanft, F. Bischoff, B. Prang (Hrsg.), Working Paper Lehr-/Lernformen. Perspektiven aus der Begleitforschung zum Qualitätspakt Lehre. Abgerufen von KoBF: Freeman, S., Eddy, SL., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H. & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematic. Proceedings of the National Academy of Sciences 11(23), 8410-8415. Glathe, A. (2017). Effekte von Tutorentraining und die Kompetenzentwicklung von MINTFachtutor* innen in Lernunterstützungsfunktion. (Nicht veröffentlichte Dissertation). Technische Universität Darmstadt, Deutschland. Kirkpatrick, D. L. (1959). Techniques for Evaluation Training Program. Journal of the American Society of Training Directors, 13, 21-26. Hänze, M. Fischer, E. Schreiber, Biehler, R. & Hochmuth, R- (2013). Innovationen in der Hochschullehre: empirische Überprüfung eines Studienprogramms zur Verbesserung von vorlesungsbegleitenden Übungsgruppen in der Mathematik. Zeitschrift für Hochschulentwicklung, 8(4), 89- 103. Kröpke, H. (2014). Who is who? Tutoring und Mentoring - der Versuch einer begrifflichen Schärfung. In D. Lenzen & H. Fischer (Hrsg.), Tutoring und Mentoring unter besonderer Berücksichtigung der Orientierungseinheit (Bd. 5). (21-29). Hamburg: Universitätskolleg-Schriften. Kühlmann, T. (2007). Fragebögen. In J. Straub, A. Weidemann & D. Weidemann (Hrsg.), Handbuch interkulturelle Kommunikation und Kompetenz (346-352). Stuttgart: Metzler. Mayring, P. (2010). Qualitative Inhaltsanalyse. Grundlagen und Techniken (11. aktualisierte und überarbeitete Auflage). Weinheim/Basel: Beltz. Mummendey, H. D. (1981). Methoden und Probleme der Kontrolle sozialer Erwünschtheit (Social Desirability). Zeitschrift für Differentielle und Diagnostische Psychologie, 2, 199-218. Rohde, J. & Block, M. (2018). Welche Herausforderungen und Bewältigungsstrategien berichten Tutor/innen der Ingenieurwissenschaften? Eine explorative Analyse von Reflexionsberichten. Vortrag auf der 47. Tagung der Deutschen Gesellschaft für Hochschuldidaktik, Karlsruhe.

	Heterogenität der Studierenden und Lösungsansätze von Tutor/-innen Jenny Alice Rohde. Posterpräsentation auf der Tagung “Tutorielle Lehre und Heterogenität”. Technische Universität Darmstadt, 16.05.2019.Hochschuldidaktische Tutorenqualifizierung - Eine Basisqualifizierung des akademischen Nachwuchses und Chance für den Wandel der Lehr-/Lernkultur? Jenny Alice Rohde & Caroline Thon-Gairola. Posterpräsentation auf der DGHD am 07.03.2019.Welches Lehrverhalten zeigen geschulte Tutor/innen? Eine explorative Analyse selbst- und fremdwahrnehmungsbasierter Reflexionsberichte Jenny Alice Rohde & Nadine Stahlberg. In: die hochschulehre (2019). Schneider, M. & Preckel, F. (2017). Variables associated with achievement in higher education: A systematic review of meta-analyse. Psychological Bulletin, 143(6), 565-600. Skylar Powell, K. & Yalcin, S. (2010). Managerial training effectiveness: A meta-analysis 1952-2002. Personnel Review, 39(2), 227-241. 27 Welches Lehrverhalten zeigen geschulte Tutor/innen d ie hochs chul l ehre 2019 www.hochschullehre.org Stes, A., Min-Leliveld, M., Gijbels, D. & Van Petegem, P. (2010). The impact of instructional development in higher education: The state-of-the-art of the research. Educational Research Review, 5(1), 25-49. Stroebe, W. (2016). Why Good Teaching Evaluations May Reward Bad Teaching: On Grade Inflation and Other Unintended Consequences of Student Evaluation. Perspectives on Psychological Science, 11(6), 800-816. Technische Universität Hamburg (2018). Kennzahlen 2017. Hamburg: Technische Universität Hamburg. [https://www.tuhh.de/tuhh/uni/informationen/kennzahlen.html] Thumser-Dauth, K. (2008). Und was bringt das? Evaluation hochschuldidaktischer Weiterbildung. In B. Berendt, H.-P. Voss & J. Wildt (Hrsg.), Neues Handbuch Hochschullehre. Lehren und Lernen effizient gestalten. Kap. L 1.11 Hochschuldidaktische Aus- und Weiterbildung. Veranstaltungskonzepte und -modelle. Berlin: Raabe. S. 1-10. Wibbecke, G. (2015): Evaluation einer hochschuldidaktischen Weiterbildung an der Medizinischen Fakultät Heidelberg. Dissertation. Ruprecht-Karls-Universität Heidelberg. Willige, J., Woisch, A., Grützmacher, J. & Naumann, H. (2015a). Randauszählung Studienqualitätsmonitor 2014, Technische Universität Hamburg-Harburg, Online-Befragung Studierender im Sommersemester 2014, DZHW - Deutsches Zentrum für Hochschul- und Wissenschaftsforschung. Willige, J., Woisch, A., Grützmacher, J. & Naumann, H. (2015b). Randauszählung Studienqualitätsmonitor 2015, Technische Universität Hamburg-Harburg, Online-Befragung Studierender im Sommersemester 2015, DZHW - Deutsches Zentrum für Hochschul- und Wissenschaftsforschung. Winkler, M. (2018). Tutorielle Lehransätze im Vergleich. Die KOMPASS Begleitforschung. Vortrag gehalten am 12.03.2018 auf dem Netzwerktreffen Tutorienarbeit an Hochschulen in Würzburg. Zech, F. (1977). Grundkurs Mathematikdidaktik: theoretische und praktische Anleitungen für das Lehren und Lernen im Fach Mathematik. Weinheim: Beltz.

Course L1509: Intercultural Communication	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	etwa 20 Minuten Präsentation und 10-20 Minuten Diskussion
Lecturer	Prof. Margarete Jarchow, Anna Katharina Bartel
Language	EN
Cycle	WiSe/SoSe
Content	As young professionals with technical background you may often tend to focus on communicating numbers and statistics in your presentations. However, facts are only one aspect of convincing others. Often, your personality, personal experience, cultural background and emotions are more important. You have to convince as a person in order to get your content across. In this workshop you will learn how to increase and express your cultural competence. You will apply cultural knowledge and images in order to positively influence communicative situations. You will learn how to add character and interest to your talks, papers and publications by referring to your own and European Cultural background. You will find out the basics of communicating professionally and convincingly by showing personality and by referring to your own cultural knowledge. You will get hands-on experience both in preparing and in conducting such communicative situations. This course is not focussing on delivering new knowledge about European culture but helps you using existing knowledge or such that you can gain e.g. in other Humanities courses. Content • How to enrich the personal character of your presentations **by referring to European and your own culture** • How to properly arrange **content and structure.** • How to use **PowerPoint for visualization** (you will use computers in an NIT room). • How to be well-prepared and convincing **when delivering** your thoughts to your audience**.**
Literature	Literaturhinweise werden zu Beginn des Seminars bekanntgegeben. Literature will be announced at the beginning of the seminar.

Course L2015: Intercultural Management - Theory and Awareness Training	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	15 Minuten Vortrag und dessen schriftliche Ausarbeitung (10 Seiten)
Lecturer	Prof Jürgen Rothlauf
Language	EN
Cycle	WiSe/SoSe
Content	The subject of the course is the deepening of the intercultural dimension of international management in relation to fundamental challenges, the importance of culture in team work and leadership of large multinational companies. In addition, culture-awareness trainings are discussed and carried out.
Literature	Rothlauf, J (2014): A Global View on Intercultural Management - Challenges in a Globalized World, De Gruyter Oldenbourg Verlag, 360 p

Course L2346: Young, educated, (non)political - are our young engineers well prepared for the future?	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	etwa 20 Minuten Präsentation und 10-20 Minuten Diskussion
Lecturer	Vincent-Immanuel Herr
Language	DE
Cycle	WiSe/SoSe
Content	Digitalization, climate change, democracy - society is facing fundamental upheavals. The next generation of young engineers in particular must no longer remain out of debate and can provide answers to the big questions of our time. Why is social commitment important? Is studying preparing us well for the future? What needs to improve? In the interactive workshop, the participants will be accompanied in analyzing their own generation and their own actions and in developing thesis on how to improve technical studies and training. The result of the seminar will be a joint thesis paper.
Literature	Wird im Seminar bekannt gegeben.

Course L2176: Culture of Communication - Theories and Methods of Successful Communication	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	etwa 20 Minuten Präsentation und 10-20 Minuten Diskussion
Lecturer	Anna Katharina Bartel
Language	DE
Cycle	WiSe/SoSe
Content	This course is for master students. In this seminar, we will explore different theories, models and methods from the fields of communication, psychology and cultural theory. The participants will work on theoretical content and do group presentations. They will also use examples from their own experiences to apply models and methods in practical exercises. The way we communicate shapes the way we experience our relationships, in the business world as well as in our private lives. We spend an overwhelming amount of time in group situations. This makes it worthwhile to explore how communication works within the group context and how, within these different groups, different cultures of communication develop. This particularly applies in highly specialized fields, such as engineering. Our ability to flexibly and successfully move from one context to another helps us along in building successful careers and allows us to feel positive about our private lives. However, this is not always simple. For example: If we are part of a context in which many conflicts arise If we have to switch between different contexts frequently Or if, on the one hand, complicated facts and data are our main focus but on the other hand, we have to communicate them to people who are not familiar with the subject. Maybe we even have to win their attention in order to help along our causes. Oftentimes, this leads to misunderstandings. There also might be a lack of openness or willingness to embrace conflict. This might make it difficult for us to reach our goals. To be able to reflect on the way we communicate, to identify patterns of communication and the ability to actively build positive relationships through communication are useful skills to help overcome those obstacles..
Literature	• Knoblauch, H. (1995). Kommunikationskultur: Die kommunikative Konstruktion kultureller Kontexte (Materiale Soziologie, Band 5). de Gruyter. • Geert Hofstede, Geert Jan Hofstede, Michael Minkov. (2010). Cultures and Organizations - Software Of The Mind:Intercultural Cooperation and Its Importance for Survival. McGraw-Hill Education. • Bay, Rolf H. (2006) Erfolgreiche Gespräche durch aktives Zuhören. Ehningen. Expert-Verlag. • Cohn, Ruth (1975). Von der Psychoanalyse zur Themenzentrierten Interaktion. Stuttgart. Klett - Cotta • Fengler, Jörg (1998) Feedback geben. Weinheim. Beltz. • Lumma, Klaus (2006). Die Teamfibel oder das Einmaleins der Team- & Gruppenqualifizierung im sozialen und betrieblichen Bereich. Windmühle. • Spies, Stefan. (2010). Der Gedanke lenkt den Körper: Körpersprache - Erfolgsstrathegien eines Regisseurs. Hoffmann und Campe.

Course L0535: Theory of Communication	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	20-30 Minuten Referat und Thesenpapier
Lecturer	Dr. Michael Florian
Language	DE
Cycle	SoSe
Content	The seminar focuses on sociological theories of communication and selected problems of practical application in the area of crisis communication. The issue of crisis communication will be analyzed on the basis of case studies.
Literature	Habermas, Jürgen (1981): Theorie des kommunikativen Handelns. 2 Bände. Frankfurt/Main: Suhrkamp. Luhmann, Niklas (1984): Soziale Systeme. Grundriß einer allgemeinen Theorie. Frankfurt/Main: Suhrkamp. Malsch, Thomas (2005): Kommunikationsanschlüsse. Zur soziologischen Differenz von realer und künstlicher Sozialität. Wiesbaden: VS Verlag für Sozialwissenschaften. Malsch, Thomas; Schmitt, Marco (Hg.) (2014): Neue Impulse für die soziologische Kommunikationstheorie. Empirische Widerstände und theoretische Verknüpfungen. Springer Fachmedien: Wiesbaden. Meckel, Miriam; Schmid, Beat F. (Hg.) (2008): Unternehmenskommunikation. Kommunikationsmanagement aus Sicht der Unternehmensführung. 2., überarbeitete und erweiterte Auflage. Gabler GWV Fachverlage: Wiesbaden. Merten, Klaus (1999): Einführung in die Kommunikationswissenschaft. Bd 1/1: Grundlagen der Kommunikationswissenschaft. Münster: Lit Verlag. Nolting, Tobias; Thießen, Ansgar (Hg.) (2008): Krisenmanagement in der Mediengesellschaft. Potenziale und Perspektiven der Krisenkommunikation. Wiesbaden: VS Verlag für Sozialwissenschaften. Schützeichel, Rainer (2004): Soziologische Kommunikationstheorien. Konstanz: UVK Verlagsgesellschaft. Thießen, Ansgar (2011): Organisationskommunikation in Krisen. Reputationsmanagement durch situative, integrierte und strategische Krisenkommunikation. VS Verlag für Sozialwissenschaften/Springer Fachmedien: Wiesbaden. Thießen, Ansgar (Hg.) (2013): Handbuch Krisenmanagement. Springer Fachmedien: Wiesbaden.

Course L1732: criminology and society - in German	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	Gruppenreferat (30 bis 45 Minuten, Eigenanteil je Person 10 bis 15 Minuten) inkl. schriftlicher Ausarbeitung, Ggf. alternativ eine längere, schriftliche Ausarbeitung.
Lecturer	Sarah Schirmer
Language	DE
Cycle	WiSe/SoSe
Content	The seminar will provide an overview of Criminology and introduce different theories of criminality. It is necessary to consider the discipline of Criminology within its historical context in order to understand how some theories have evolved. The students will use this knowledge of Criminology theory to discuss and consider the advantages and disadvantages of each theory. Discussions will include how society constructs crime as well as a more philosophical debate about a determined view.
Literature	Wird zeitnah bekannt gegeben. Will be announced in lecture.

Course L2369: Literature and Culture for international students of Master's degree programs in English (non-native speakers of German)	
Typ	Seminar
Hrs/wk	4
CP	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Examination Form	Referat
Examination duration and scale	45 min. Präsentation und anschließende Diskussion
Lecturer	Bertrand Schütz
Language	DE
Cycle	WiSe/SoSe
Content	The seminar LITERATURE AND CULTURE investigates what culture is, especially what characterises epistemic cultures. Culture is to be understood as the creative response to a given situation and the capacity to integrate inputs and influences, therefore as an ongoing process of permanent readjustment and learning, and by no means as a fixed identity in terms of an “essence”. There is a growing awareness that Europe cannot lay claim to possess the ultimate standards of knowledge. A topography of our contemporary world is to be sketched by highlighting its historical and cultural premises. For more information please refer to the German description and the StudIP.
Literature	Je nach Thematik des Semesters wird eine spezifische Literatur-Liste erstellt. cf. StudIP

Course L1837: People in Business Organizations	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	Schriftliche Hausarbeit 7-10 Textseiten; verpflichtend: Präsentation der Zwischenergebnisse mit Diskussion (geht nicht in die Bewertung mit ein)
Lecturer	Dr. Martin Schütz
Language	DE
Cycle	WiSe/SoSe
Content	The influence of technological change and social change on business organizations - how to manage the organizational change.
Literature	Becker, Karen Louise (2007): Unlearning in the workplace. A mixed methods study. PhD. Queensland University of Technology, Brisbane. Faculty of Education. Online verfügbar unter http://eprints.qut.edu.au/16574/. Frey, Dieter; Gerkhardt, Marit; Peus, Claudia; Traut-Mattausch, Eva; Fischer, Peter (2014): Veränderungen managen. Widerstände und Erfolgsfaktoren der Umsetzung. In: Lutz von Rosenstiel, Erika Regnet und Michel E. Domsch (Hg.): Führung von Mitarbeitern. Handbuch für erfolgreiches Personalmanagement. 7. Aufl. Stuttgart: Schäffer-Poeschel, S. 547-559. Hauser, Berndhard (2014): Konflikte in und zwischen Gruppen. In: Lutz von Rosenstiel, Erika Regnet und Michel E. Domsch (Hg.): Führung von Mitarbeitern. Handbuch für erfolgreiches Personalmanagement. 7. Aufl. Stuttgart: Schäffer-Poeschel, S. 354-367. Kieser, Alfred; Walgenbach, Peter (2007): Organisation. 5. Aufl. Stuttgart: Schäffer-Poeschel. Miebach, Bernhard (2012): Organisationstheorie. Problemstellung - Modelle - Entwicklung. 2. Aufl. Wiesbaden: Springer Fachmedien Wiesbaden; Imprint: Springer VS. Müller, Ursula (Hg.) (2013): Geschlecht und Organisation. Wiesbaden: Springer VS (Geschlecht und Gesellschaft, 45). Olfert, Klaus (2012): Organisation. 16. Aufl. Herne: NWB Verlag. Pohlmann, Markus; Markova, Hristina (2011): Soziologie der Organisation. Eine Einführung. Konstanz, München: UVK-Verl.-Ges. (3573). Preisendörfer, Peter (2011): Organisationssoziologie. Grundlagen, Theorien und Problemstellungen. 3. Aufl. Wiesbaden: VS Verlag für Sozialwissenschaften. Robbins, Stephen P.; Judge, Timothy A. (2013): Organizational Behavior. 15. Aufl. Boston, Mass: Pearson. Rosenstiel, Lutz von; Nerdinger, Friedemann W. (2011): Grundlagen der Organisationspsychologie. Basiswissen und Anwendungshinweise. 7. Aufl. Stuttgart: Schäffer-Poeschel. Sanders, Karin; Kianty, Andrea (2006): Organisationstheorien. Eine Einführung. 1. Aufl. Wiesbaden: VS Verlag für Sozialwissenschaften. Schreyögg, Georg (2008): Organisation. Grundlagen moderner Organisationsgestaltung, mit Fallstudien. 5. Aufl. Wiesbaden: Gabler (Lehrbuch). Vahs, Dietmar (2012): Organisation. Ein Lehr- und Managementbuch. 8. Aufl. Stuttgart: Schäffer-Poeschel. Weinert, Ansfried B. (2004): Organisations- und Personalpsychologie. 5. Aufl. Weinheim: BeltzPVU.

Course L1846: Classical Journalism and New Media	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	Ca. 20 min. plus anschließende Diskussion
Lecturer	Dieter Bednarz
Language	DE
Cycle	WiSe/SoSe
Content	The world wide walkover of the internet dramatically changed the perception of classical media like newspapers, magazines and even TV. In this seminar the reasons of and the consequences for the dramatic changes regarding our information habits will be analyzed and discussed. Has the media expert Neil Postman been right, when he one said, that we all one day will be „overnewsed but underinformed“? Keeping a close eye on the real challenges of journalism, the seminar will discuss the standards of ethics in politics and media.
Literature	Wird im Seminar genannt

Course L1023: Politics	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	etwa 20 Minuten Präsentation und 10-20 Minuten Diskussion
Lecturer	Dr. Stephan Albrecht
Language	EN
Cycle	WiSe/SoSe
Content	Scientists and engineers neither just strive for truths and scientific laws, nor are they working in a space far from politics. Science and engineering have contributed to what we now call the Anthropocene, the first time in the history of mankind when essential cycles of the earth system, e.g. carbon cycle, climate system, are heavily influenced or even shattered. Furthermore, Peak oil is indicating the end of cheap fossil energy thus triggering the search for alternatives such as biomass. Systems of knowledge, science and technology in the OECD countries have since roughly 30 years increasingly become divided. On the one hand new technologies such as modern biotechnology, IT or nanotechnology are developing rapidly, bringing about many innovations for industry, agriculture, and consumers. On the other hand scientific studies from earth, environmental, climate change, agricultural and social sciences deliver increasingly robust evidence on more or less severe impacts on society, environment, global equity, and economy resulting from innovations during the last 50 years. Technological innovation thus is no longer an uncontested concept. And many protest movements demonstrate that the introduction of new or the enlargement of existing technologies (e.g. airports, railway stations, highways, high-voltage power lines surveillance) isn't at all a matter of course. It is important to bear in mind the fact that all processes of technological innovation are made by humans, individually and collectively. Industrial, social, and political organizations as actors from the local to global level of communication, deliberation, and decision making interact in diverse arenas, struggling to promote their respective corporate and/or political agenda. So innovations are as well a problem of technology as a problem of politics. Innovation and technology policies aren't the same in all countries. We can observe conceptual and practical variations. Since the 1992 Earth Summit in Rio de Janeiro Agenda 21 constitutes a normative umbrella, indicating Sustainable Development (SD) as core cluster of earth politics on all levels from local to global. Meanwhile other documents such as the Millennium Development Goals (MDG) have complemented the SD agenda. SD can be interpreted as operationalization of the Universal Declaration of Human Rights, adopted in 1948 by the General Assembly of the United Nations and since amended many times. Engineers and scientists as professionals can't avoid to become confronted with many non-technical and non-disciplinary items, challenges, and dilemmas. So they have to choose between alternative options for action, as individuals and as members of organizations or employees. Therefore the seminar will address core elements of the complex interrelations between science, society and politics. Reflections on experiences of participants - e.g. from other countries as Germany - during the seminar are very welcome. The goals of the seminar include: • Raising awareness and increasing knowledge about the political implications of scientific work and institutions; • Improving the understanding of different concepts and designs of innovation and technology policies; • Increasing knowledge about the status and perspectives of sustainable development as framework concept for technological and scientific progress; • Understanding core elements of recent arguments, conflicts, and crises on technological innovations, e.g. geo-engineering or bio-economy; • Improving the understanding of scientists' responsibility for impacts of their professional activities; • Embedding individual professional responsibility in social and political contexts. The seminar will deal with current problems from areas such as innovation policy, energy, food systems, and raw materials. Issues will include the future of energy, food security and electronics. Historical issues will also be addressed. The seminar will start with a profound overarching introduction. Issues will be introduced by a short presentation and a Q & A session, followed by group work on selected problems. All participants will have to prepare a presentation during the weekend seminar. The seminar will use inter alia interactive tools of teaching such as focus groups, simulations and presentations by students. Regular and active participation is required at all stages.
Literature	Literatur wird zu Beginn des Seminars abgesprochen.

Course L1856: Politics and Science - in German	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	Referat ca. 20 min. plus anschließende Diskussion
Lecturer	Dr. Mirko Himmel, Dr. Ines Krohn-Molt
Language	DE
Cycle	WiSe/SoSe
Content	Scientists often like to believe that their work is non-political. Within this seminar we want to demonstrate how deeply both are interconnected and converged. Not only, scientific guidance is often needed to take a political decision but also scientific outcomes are a sub-ject to political interpretation. Also, politics are significantly influencing scientific progress by framing research agendas and by funding decisions.
Literature	Wird im Seminar genannt

Course L1779: Politics and Science - in English	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	etwa 20 Minuten Präsentation und 10-20 Minuten Diskussion
Lecturer	Dr. Frederik Postelt, Dr. Gunnar Jeremias
Language	EN
Cycle	WiSe/SoSe
Content	Scientists often like to believe that their work is non-political. Within this seminar we want to demonstrate how deeply both are interconnected and converged. Not only, scientific guidance is often needed to take a political decision but also scientific outcomes are a sub-ject to political interpretation. Also, politics are significantly influencing scientific progress by framing research agendas and by funding decisions. During this seminar we would like to show the different range of influences - scientific, economic, social, environmental, ethical/normative, security-related - affecting decision-making on science and politics. Using case studies on current debates on food security, public health, nuclear energy and terrorism to discuss the interrelation between science and politics illuminating the role of various actors in this process, such as: • Governments, • International organizations, • Scientific associations, • Industry, • Civil society, and • Individual scientists. The guiding questions will be: • How does and should science influence politics? • How does and should politics influence science? In order to take responsibility for the consequences of scientific work, engineers and scientists increasingly need to acknowledge the political dimension of their work and their role in the political process. We will address this political dimension of scientific work by discussing: • Biographies and motivations of famous scientists, • Individual responsibility of scientists for the implications of their work, and • The role of codes of conduct as guidelines for responsible behaviour. The goals of the seminar include: • Raising awareness and increasing knowledge about the political dimensions of scientific work, • Providing guidelines for evaluating political implications of scientific research, • Improving the understanding of scientists' and engineers' responsibility for the results of their professional activities, • Taking decisions at the institutional, national and international level about rules and regulations concerning scientific conduct, and • Choosing arguments and defending positions in situations of conflicting interests. The seminar will use current issues, such as dilemmas in the life sciences or bio fuels to demonstrate the problematic relationship between science and politics. The seminar, however, does not focus on providing in-depth knowledge of these current issues. We strongly discourage students that have participated in an "Ethics for Engineers" seminar to take this course, because the contents of the two seminars overlap. Issues will be introduced by short presentations and a Q&A session, followed by group work on selected problems. All participants will have to prepare a presentation. Those requiring a graded certificate ("Schein") additionally have to write a 3-4 page paper on selected issues. The seminar will use interactive tools of teaching such as role playing and simulations. Group work and active participation is expected at all stages of the seminar.
Literature	will be announced in lecture wird im Seminar bekannt gegeben

Course L1734: Projectrealisation: TUHH goes circular - Sustainability in Research, Education and campus management	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	
Lecturer	Prof. Kerstin Kuchta
Language	EN
Cycle	WiSe/SoSe
Content	
Literature	Wird im Seminar bekanntgegeben Will be announced in lecture.

Course L1872: Social Learning: Social Commitment in Refugee Issues / Master	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	10 Seiten
Lecturer	Muthana Al-Temimi
Language	DE
Cycle	WiSe/SoSe
Content	folgt
Literature	Wird im Seminar bekannt gegeben. Will be announced in lecture.

Course L1647: Soft skill seminar for dual study programme (dual@TUHH) / Master	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	Referat mit 2-3 Videoübungen à 20 Minuten + anschließende Diskussion
Lecturer	Silke Wolckenhaar-Wagner, Dr. Henning Haschke
Language	DE
Cycle	WiSe/SoSe
Content	
Literature	

Course L1771: The Arabic Spring an its Consequences	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	etwa 20 Minuten Präsentation und 10-20 Minuten Diskussion
Lecturer	Dieter Bednarz
Language	DE
Cycle	WiSe/SoSe
Content	The world wide walkover of the internet dramatically changed the perception of classical media like newspapers, magazines and even TV. In this seminar the reasons of and the consequences for the dramatic changes regarding our information habits will be analyzed and discussed: Taking a close look at the Middle East the political impact of the new media´s triumphal procession will be assessed and evaluated. How come that Twitter and Facebook on one hand facilitated the so called Arabic Spring and caused hope for the rise of democracy in the region, while on the other hand the revolutionaries failed so dramatically - at least for now. Keeping a close eye on both fields, the Media and the Middle East, the seminar will discuss the standards of ethics in politics and journalism.
Literature	Wird im Seminar angegeben und besprochen. Will be announced in the lecture.

Course L1916: Responsible Conduct in Technology & Science	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	etwa 20 Minuten Präsentation und 10-20 Minuten Diskussion
Lecturer	Dr. Mirko Himmel, Dr. Ines Krohn-Molt
Language	DE
Cycle	WiSe/SoSe
Content	Aim of the seminar is raising awareness for the responsibility of engineers and researchers for a proper and ethical conduct in technology and science. The Participants will present and discuss practical examples for good as well as bad conduct in science.
Literature	folgt im Seminar

Course L1991: What can philosophy do?	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	etwa 20 Minuten Präsentation und 10-20 Minuten Diskussion
Lecturer	Dr. Ursula Töller
Language	DE
Cycle	WiSe/SoSe
Content	Over the centuries, the philosophy is lined up as a discipline that provides complex and universal answers to contemporary history and circumstances. Often, she could design utopias that have led the way for political upheaval. While all scientific disciplines are subject to an increasing differentiation, the philosophy in the second half of the 20th century has lost its claim to universality. But what then are the topics of the philosophy of the 20th and 21st century and what impact have philosophical theories for processes of change? We will provide an overview of Western philosophies of the 20th and 21st century. and take a critical look at the self-understanding of philosophy.
Literature	Gerhardt Schweppenhäuser: Kritische Theorie, Stuttgart 2010 Postmoderne und Dekonstruktion, Texte französischer Philosophen der Gegenwart, hrsg. von Peter Engelmann, Reclam UB 8668 Thomas Rentsch: Philosophie des 20. Jhdts. Von Husserl bis Derrida, München 2014 Geschichte der Philosophie in Text und Darstellung, Bd. 8=20 Jhdt. Reclam UB 9918 Geschichte der Philosophie in Text und Darstellung, Bd. 9= Gegenwart Reclam UB 18267

Course L2343: Academic Writing and Presentation for Master-Students	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	etwa 20 Minuten Präsentation und 10-20 Minuten Diskussion
Lecturer	Dr. Ursula Töller
Language	DE
Cycle	WiSe/SoSe
Content	The course is aimed at Master students who are planning to write their thesis, want to pursue their PhD or intend to present their research results at conferences and in journals. The course is structured on three levels: 1. writing, 2. presenting and 3. interacting in organizational structures. The latter refers to the work environment at university as well as in research groups and enterprises. In the course of the seminar, the participants become acquainted with various methods and theories on the subject. Furthermore, the methods and theories will be put into practice, reflected upon and discussed as part of the seminar.
Literature	• Umberto Eco, Wie man eine wiss. Abschlussarbeit schreibt (2010) • Helga Esselborn-Krumbiegel, Von der Idee zum Text. Eine Anleitung zum wissenschaftlichen Schreiben (2008) • Tony Buzan: Das Mind-Map-Buch. (2001) • John W. Chinneck: How to organize your Thesis (1999) • Lothar Seiwert: Das neue 1x1 des Zeitmanagements (2003) • Steven R. Covey: Die sieben Wege der Effektivität (2000) • Harold Kerzner: Twenty Common Mistakes Made by New or Inexperienced Project Manager (2010) • Friedemann Schulz von Thun: Miteinander Reden. (1996) Tim McClintock: Dealing with Specific Types of Difficult People. (2008)

Course L2029: “Lying press”? Functions and current challenges of journalism	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	20 min
Lecturer	Prof. Horst Pöttker
Language	DE
Cycle	WiSe/SoSe
Content	Lying press - there is a revival of the disparaging invective. Journalists use to shoot it down by leading it back to its supposed roots in the NS-propaganda. This is less convincing as several parties and ideologies have used it since the middle of the 19th century to discredit the media of other parties and ideologies. And it is missing the core of the problem. Critics are reasonably afraid that the choice of “lying press” to the “non-word of the year” 2014 has blocked the question, if there is a justified criticism of information media and journalism - or more precisely of the relationship between journalism and its audience. If this is the case both - journalism and audience - are involved from the perspective of inter actionism. Against this background interactive instructions will be given by scholarly literature and practical examples from the German and international media business. Questions like the following will be discussed: • Is journalism really a profession? If so - since when? • What is journalism for? (task and duties, functions, self-images) • Do the audience and journalists themselves have a reasonable understanding of tasks, functions, practices, problems of journalism? • What is the current concept of journalistic professionalism? Has it ever been the same? • From an international perspective: Does journalism in Germany have special shortcomings - if so, how can they be removed? • What are the economic challenges for journalism from the digital media upheaval? • In which direction do journalistic professionalism and self-understanding change in the digital media world? Objective is solid learning about professional tasks, ethics, techniques, endagerments, history and current problems of journalism including science journalism.
Literature	Zur Einführung: Lilienthal, Volker/Neverla, Irene (Hrsg.) (2017): „Lügenpresse“. Anatomie eines politischen Kampfbegriffs. Köln: Kiepenheuer & Witsch. https://www.kiwi-verlag.de/buch/luegenpresse/978-3-462-31782-4/ Pöttker, Horst (2010): Der Beruf zur Öffentlichkeit. Über Aufgabe, Grundsätze und Perspektiven des Journalismus in der Mediengesellschaft aus der Sicht praktischer Vernunft. In: Publizistik, 55. Jg., H. 2, S. 107-128. https://www.springerprofessional.de/en/der-beruf-zur-oeffentlichkeit/5889108 Weischenberg, S. (2007): Das *Jahrhundert des Journalismus* ist vorbei. Rekonstruktionen und Prognosen zur Formation gesellschaftlicher Selbstbeobachtung. In: *Bartelt-Kircher*, G. et al.: Krise der Printmedien - eine Krise des Journalismus? Berlin und New York, de Gruyter Saur, S. 32-60. https://medien21.wordpress.com/2011/10/17/weischenberg-das-jahrhundert-des-journalismus-ist-vorbei/ Eine ausführliche Literaturliste wird am Anfang des Seminars verteilt.

Module M0603: Nonlinear Structural Analysis

Courses

Title	Typ	Hrs/wk	CP
Nonlinear Structural Analysis (L0277)	Lecture	3	4
Nonlinear Structural Analysis (L0279)	Recitation Section (small)	1	2

Module Responsible	Prof. Alexander Düster
Admission Requirements	None
Recommended Previous Knowledge	Knowledge of partial differential equations is recommended.
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to + give an overview of the different nonlinear phenomena in structural mechanics. + explain the mechanical background of nonlinear phenomena in structural mechanics. + to specify problems of nonlinear structural analysis, to identify them in a given situation and to explain their mathematical and mechanical background.
Skills	Students are able to + model nonlinear structural problems. + select for a given nonlinear structural problem a suitable computational procedure. + apply finite element procedures for nonlinear structural analysis. + critically verify and judge results of nonlinear finite elements. + to transfer their knowledge of nonlinear solution procedures to new problems.
Personal Competence	
Social Competence	Students are able to + solve problems in heterogeneous groups and to document the corresponding results. + share new knowledge with group members.
Autonomy	Students are able to + acquire independently knowledge to solve complex problems.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory Materials Science: Specialisation Modeling: Elective Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Product Development, Materials and Production: Core Qualification: Elective Compulsory Naval Architecture and Ocean Engineering: Core Qualification: Elective Compulsory Ship and Offshore Technology: Core Qualification: Elective Compulsory Theoretical Mechanical Engineering: Core Qualification: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

Course L0277: Nonlinear Structural Analysis

Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Alexander Düster
Language	DE/EN
Cycle	WiSe
Content	1. Introduction 2. Nonlinear phenomena 3. Mathematical preliminaries 4. Basic equations of continuum mechanics 5. Spatial discretization with finite elements 6. Solution of nonlinear systems of equations 7. Solution of elastoplastic problems 8. Stability problems 9. Contact problems
Literature	[1] Alexander Düster, Nonlinear Structrual Analysis, Lecture Notes, Technische Universität Hamburg-Harburg, 2014. [2] Peter Wriggers, Nonlinear Finite Element Methods, Springer 2008. [3] Peter Wriggers, Nichtlineare Finite-Elemente-Methoden, Springer 2001. [4] Javier Bonet and Richard D. Wood, Nonlinear Continuum Mechanics for Finite Element Analysis, Cambridge University Press, 2008.

Course L0279: Nonlinear Structural Analysis	
Typ	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Alexander Düster
Language	DE/EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0742: Thermal Engineering

Courses			
Title	**Typ**	**Hrs/wk**	**CP**
Thermal Engineering (L0023)	Lecture	3	5
Thermal Engineering (L0024)	Recitation Section (large)	1	1

Module Responsible	Prof. Gerhard Schmitz
Admission Requirements	None
Recommended Previous Knowledge	Technical Thermodynamics I, II, Fluid Dynamics, Heat Transfer
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students know the different energy conversion stages and the difference between efficiency and annual efficiency. They have increased knowledge in heat and mass transfer, especially in regard to buildings and mobile applications. They are familiar with German energy saving code and other technical relevant rules. They know to differ different heating systems in the domestic and industrial area and how to control such heating systems. They are able to model a furnace and to calculate the transient temperatures in a furnace. They have the basic knowledge of emission formations in the flames of small burners and how to conduct the flue gases into the atmosphere. They are able to model thermodynamic systems with object oriented languages.
Skills	Students are able to calculate the heating demand for different heating systems and to choose the suitable components. They are able to calculate a pipeline network and have the ability to perform simple planning tasks, regarding solar energy. They can write Modelica programs and can transfer research knowledge into practice. They are able to perform scientific work in the field of thermal engineering.
Personal Competence	
Social Competence	The students are able to discuss in small groups and develop an approach.
Autonomy	Students are able to define independently tasks, to get new knowledge from existing knowledge as well as to find ways to use the knowledge in practice.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	60 min
Assignment for the Following Curricula	Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Energy and Environmental Engineering: Specialisation Energy Engineering: Elective Compulsory Energy Systems: Specialisation Energy Systems: Compulsory Energy Systems: Specialisation Marine Engineering: Elective Compulsory International Management and Engineering: Specialisation II. Energy and Environmental Engineering: Elective Compulsory Product Development, Materials and Production: Core Qualification: Elective Compulsory Renewable Energies: Core Qualification: Compulsory Theoretical Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Process Engineering: Specialisation Process Engineering: Elective Compulsory

Course L0023: Thermal Engineering	
Typ	Lecture
Hrs/wk	3
CP	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Gerhard Schmitz
Language	DE
Cycle	WiSe
Content	1. Introduction 2. Fundamentals of Thermal Engineering 2.1 Heat Conduction 2.2 Convection 2.3 Radiation 2.4 Heat transition 2.5 Combustion parameters 2.6 Electrical heating 2.7 Water vapor transport 3. Heating Systems 3.1 Warm water heating systems 3.2 Warm water supply 3.3 piping calculation 3.4 boilers, heat pumps, solar collectors 3.5 Air heating systems 3.6 radiative heating systems 4. Thermal traetment systems 4.1 Industrial furnaces 4.2 Melting furnaces 4.3 Drying plants 4.4 Emission control 4.5 Chimney calculation 4.6 Energy measuring 5. Laws and standards 5.1 Buildings 5.2 Industrial plants
Literature	• Schmitz, G.: Klimaanlagen, Skript zur Vorlesung • VDI Wärmeatlas, 11. Auflage, Springer Verlag, Düsseldorf 2013 • Herwig, H.; Moschallski, A.: Wärmeübertragung, Vieweg+Teubner Verlag, Wiesbaden 2009 • Recknagel, H.; Sprenger, E.; Schrammek, E.-R.: Taschenbuch für Heizung- und Klimatechnik 2013/2014, 76. Auflage, Deutscher Industrieverlag, 2013

Course L0024: Thermal Engineering	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Gerhard Schmitz
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0751: Vibration Theory

Courses			
Title	**Typ**	**Hrs/wk**	**CP**
Vibration Theory (L0701)	Integrated Lecture	4	6

Module Responsible	Prof. Norbert Hoffmann
Admission Requirements	None
Recommended Previous Knowledge	• Calculus • Linear Algebra • Engineering Mechanics
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to denote terms and concepts of Vibration Theory and develop them further.
Skills	Students are able to denote methods of Vibration Theory and develop them further.
Personal Competence	
Social Competence	Students can reach working results also in groups.
Autonomy	Students are able to approach individually research tasks in Vibration Theory.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	2 Hours
Assignment for the Following Curricula	Energy Systems: Core Qualification: Elective Compulsory International Management and Engineering: Specialisation II. Mechatronics: Elective Compulsory Mechanical Engineering and Management: Specialisation Mechatronics: Elective Compulsory Mechatronics: Core Qualification: 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 Product Development, Materials and Production: Core Qualification: Compulsory Naval Architecture and Ocean Engineering: Core Qualification: Elective Compulsory Theoretical Mechanical Engineering: Core Qualification: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

Course L0701: Vibration Theory

Typ	Integrated Lecture
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Norbert Hoffmann
Language	DE/EN
Cycle	WiSe
Content	Linear and Nonlinear Single and Multiple Degree of Freedom Oscillations and Waves.
Literature	K. Magnus, K. Popp, W. Sextro: Schwingungen. Physikalische Grundlagen und mathematische Behandlung von Schwingungen. Springer Verlag, 2013.

Module M0808: Finite Elements Methods

Courses

Title	Typ	Hrs/wk	CP
Finite Element Methods (L0291)	Lecture	2	3
Finite Element Methods (L0804)	Recitation Section (large)	2	3

Module Responsible	Prof. Otto von Estorff
Admission Requirements	None
Recommended Previous Knowledge	Mechanics I (Statics, Mechanics of Materials) and Mechanics II (Hydrostatics, Kinematics, Dynamics) Mathematics I, II, III (in particular differential equations)
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students possess an in-depth knowledge regarding the derivation of the finite element method and are able to give an overview of the theoretical and methodical basis of the method.
Skills	The students are capable to handle engineering problems by formulating suitable finite elements, assembling the corresponding system matrices, and solving the resulting system of equations.
Personal Competence	
Social Competence	Students can work in small groups on specific problems to arrive at joint solutions.
Autonomy	The students are able to independently solve challenging computational problems and develop own finite element routines. Problems can be identified and the results are critically scrutinized.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	**Compulsory** / **Bonus** / **Form** / **Description** No / 20 % / Midterm /
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	Civil Engineering: Core Qualification: Compulsory Energy Systems: Core Qualification: Elective Compulsory Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Air Transportation Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Air Transportation Systems: Elective Compulsory International Management and Engineering: Specialisation II. Mechatronics: Elective Compulsory International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory International Management and Engineering: Specialisation II. Mechatronics: Elective Compulsory International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Mechatronics: Core Qualification: Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Product Development, Materials and Production: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Theoretical Mechanical Engineering: Core Qualification: Compulsory

Course L0291: Finite Element Methods	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Otto von Estorff
Language	EN
Cycle	WiSe
Content	- General overview on modern engineering - Displacement method - Hybrid formulation - Isoparametric elements - Numerical integration - Solving systems of equations (statics, dynamics) - Eigenvalue problems - Non-linear systems - Applications - Programming of elements (Matlab, hands-on sessions) - Applications
Literature	Bathe, K.-J. (2000): Finite-Elemente-Methoden. Springer Verlag, Berlin

Course L0804: Finite Element Methods	
Typ	Recitation Section (large)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Otto von Estorff
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0846: Control Systems Theory and Design

Courses

Title	Typ	Hrs/wk	CP
Control Systems Theory and Design (L0656)	Lecture	2	4
Control Systems Theory and Design (L0657)	Recitation Section (small)	2	2

Module Responsible	Prof. Herbert Werner
Admission Requirements	None
Recommended Previous Knowledge	Introduction to Control Systems
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students can explain how linear dynamic systems are represented as state space models; they can interpret the system response to initial states or external excitation as trajectories in state space • They can explain the system properties controllability and observability, and their relationship to state feedback and state estimation, respectively • They can explain the significance of a minimal realisation • They can explain observer-based state feedback and how it can be used to achieve tracking and disturbance rejection • They can extend all of the above to multi-input multi-output systems • They can explain the z-transform and its relationship with the Laplace Transform • They can explain state space models and transfer function models of discrete-time systems • They can explain the experimental identification of ARX models of dynamic systems, and how the identification problem can be solved by solving a normal equation • They can explain how a state space model can be constructed from a discrete-time impulse response
Skills	• Students can transform transfer function models into state space models and vice versa • They can assess controllability and observability and construct minimal realisations • They can design LQG controllers for multivariable plants • They can carry out a controller design both in continuous-time and discrete-time domain, and decide which is appropriate for a given sampling rate • They can identify transfer function models and state space models of dynamic systems from experimental data • They can carry out all these tasks using standard software tools (Matlab Control Toolbox, System Identification Toolbox, Simulink)
Personal Competence	
Social Competence	Students can work in small groups on specific problems to arrive at joint solutions.
Autonomy	Students can obtain information from provided sources (lecture notes, software documentation, experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	Computer Science: Specialisation Intelligence Engineering: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory Energy Systems: Core Qualification: Elective Compulsory Aircraft Systems Engineering: Specialisation Aircraft Systems: Compulsory Aircraft Systems Engineering: Specialisation Avionic and Embedded Systems: Elective Compulsory Computational Science and Engineering: Specialisation II. Engineering Science: Elective Compulsory International Management and Engineering: Specialisation II. Electrical Engineering: Elective Compulsory International Management and Engineering: Specialisation II. Mechatronics: Elective Compulsory Mechanical Engineering and Management: Specialisation Mechatronics: Elective Compulsory Mechatronics: Core Qualification: 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: Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Product Development, Materials and Production: Core Qualification: Elective Compulsory Theoretical Mechanical Engineering: Core Qualification: Compulsory

Course L0656: Control Systems Theory and Design	
Typ	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	EN
Cycle	WiSe
Content	State space methods (single-input single-output) • State space models and transfer functions, state feedback • Coordinate basis, similarity transformations • Solutions of state equations, matrix exponentials, Caley-Hamilton Theorem • Controllability and pole placement • State estimation, observability, Kalman decomposition • Observer-based state feedback control, reference tracking • Transmission zeros • Optimal pole placement, symmetric root locus Multi-input multi-output systems • Transfer function matrices, state space models of multivariable systems, Gilbert realization • Poles and zeros of multivariable systems, minimal realization • Closed-loop stability • Pole placement for multivariable systems, LQR design, Kalman filter Digital Control • Discrete-time systems: difference equations and z-transform • Discrete-time state space models, sampled data systems, poles and zeros • Frequency response of sampled data systems, choice of sampling rate System identification and model order reduction • Least squares estimation, ARX models, persistent excitation • Identification of state space models, subspace identification • Balanced realization and model order reduction Case study • Modelling and multivariable control of a process evaporator using Matlab and Simulink Software tools • Matlab/Simulink
Literature	• Werner, H., Lecture Notes „Control Systems Theory and Design“ • T. Kailath "Linear Systems", Prentice Hall, 1980 • K.J. Astrom, B. Wittenmark "Computer Controlled Systems" Prentice Hall, 1997 • L. Ljung "System Identification - Theory for the User", Prentice Hall, 1999

Course L0657: Control Systems Theory and Design	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1150: Continuum Mechanics

Courses

Title	Typ	Hrs/wk	CP
Continuum Mechanics (L1533)	Lecture	2	3
Continuum Mechanics Exercise (L1534)	Recitation Section (small)	2	3

Module Responsible	Prof. Christian Cyron
Admission Requirements	None
Recommended Previous Knowledge	Basics of linear continuum mechanics as taught, e.g., in the module Mechanics II (forces and moments, stress, linear strain, free-body principle, linear-elastic constitutive laws, strain energy).
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students can explain the fundamental concepts to calculate the mechanical behavior of materials.
Skills	The students can set up balance laws and apply basics of deformation theory to specific aspects, both in applied contexts as in research contexts.
Personal Competence	
Social Competence	The students are able to develop solutions, to present them to specialists in written form and to develop ideas further.
Autonomy	The students are able to assess their own strengths and weaknesses. They can independently and on their own identify and solve problems in the area of continuum mechanics and acquire the knowledge required to this end.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	45 min
Assignment for the Following Curricula	Materials Science: Specialisation Modeling: Elective Compulsory Mechanical Engineering and Management: Specialisation Materials: 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 Product Development, Materials and Production: Core Qualification: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Core Qualification: Elective Compulsory

Course L1533: Continuum Mechanics

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Christian Cyron
Language	DE
Cycle	WiSe
Content	• kinematics of undeformed and deformed bodies • balance equations (balance of mass, balance of energy, …) • stress states • material modelling
Literature	R. Greve: Kontinuumsmechanik: Ein Grundkurs für Ingenieure und Physiker I-S. Liu: Continuum Mechanics, Springer

Course L1534: Continuum Mechanics Exercise	
Typ	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Christian Cyron
Language	DE
Cycle	WiSe
Content	• kinematics of undeformed and deformed bodies • balance equations (balance of mass, balance of energy, ...) • stress states • material modelling
Literature	R. Greve: Kontinuumsmechanik: Ein Grundkurs für Ingenieure und Physiker I-S. Liu: Continuum Mechanics, Springer

Module M1151: Material Modeling

Courses			
Title	**Typ**	**Hrs/wk**	**CP**
Material Modeling (L1535)	Lecture	2	3
Material Modeling (L1536)	Recitation Section (small)	2	3

Module Responsible	Prof. Christian Cyron
Admission Requirements	None
Recommended Previous Knowledge	Basics of linear and nonlinear continuum mechanics as taught, e.g., in the modules Mechanics II and Continuum Mechanics (forces and moments, stress, linear and nonlinear strain, free-body principle, linear and nonlinear constitutive laws, strain energy)
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students can explain the fundamentals of multidimensional consitutive material laws
Skills	The students can implement their own material laws in finite element codes. In particular, the students can apply their knowledge to various problems of material science and evaluate the corresponding material models.
Personal Competence	
Social Competence	The students are able to develop solutions, to present them to specialists and to develop ideas further.
Autonomy	The students are able to assess their own strengths and weaknesses. They can independently and on their own identify and solve problems in the area of materials modeling and acquire the knowledge required to this end.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	45 min
Assignment for the Following Curricula	Computational Science and Engineering: Specialisation Scientific Computing: Elective Compulsory Materials Science: Specialisation Modeling: Elective Compulsory Mechanical Engineering and Management: Specialisation Materials: 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 Product Development, Materials and Production: Core Qualification: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Materials Science: Elective Compulsory

Course L1535: Material Modeling

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Christian Cyron
Language	DE
Cycle	WiSe
Content	One of the most important questions when modeling mechanical systems in practice is how to model the behavior of the materials of their different components. In addition to simple isotropic elasticity in particular the following phenomena play key roles - anisotropy (material behavior depending on direction, e.g., in fiber-reinforced materials) - plasticity (permanent deformation due to one-time overload, e.g., in metal forming) - viscoelasticity (absorption of energy, e.g., in dampers) - creep (slow deformation under permanent load, e.g., in pipes) This lecture briefly introduces the theoretical foundations and mathematical modeling of the above phenomena. It is complemented by exercises where simple examples problems are solved by calculations and where the implementation of the content of the lecture in computer simulations is explained. It will also briefly discussed how important material parameters can be determined from experimental data.
Literature	

Course L1536: Material Modeling	
Typ	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Christian Cyron
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1173: Applied Statistics

Courses			
Title	**Typ**	**Hrs/wk**	**CP**
Applied Statistics (L1584)	Lecture	2	3
Applied Statistics (L1586)	Project-/problem-based Learning	2	2
Applied Statistics (L1585)	Recitation Section (small)	1	1

Module Responsible	Prof. Michael Morlock
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge of statistical methods
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can explain the statistical methods and the conditions of their use.
Skills	Students are able to use the statistics program to solve statistics problems and to interpret and depict the results
Personal Competence	
Social Competence	Team Work, joined presentation of results
Autonomy	To understand and interpret the question and solve
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	**Compulsory** Yes; **Bonus** None; **Form** Written elaboration; **Description**
Examination	Written exam
Examination duration and scale	90 minutes, 28 questions
Assignment for the Following Curricula	Mechanical Engineering and Management: Specialisation Management: Elective Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory Biomedical Engineering: Core Qualification: Compulsory Product Development, Materials and Production: Core Qualification: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Bio- and Medical Technology: Elective Compulsory

Course L1584: Applied Statistics

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Michael Morlock
Language	DE/EN
Cycle	WiSe
Content	The goal is to introduce students to the basic statistical methods and their application to simple problems. The topics include: • Chi square test • Simple regression and correlation • Multiple regression and correlation • One way analysis of variance • Two way analysis of variance • Discriminant analysis • Analysis of categorial data • Chossing the appropriate statistical method • Determining critical sample sizes
Literature	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, CB © 1998, ISBN/ISSN: 0-534-20910-6

Course L1586: Applied Statistics	
Typ	Project-/problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Michael Morlock
Language	DE/EN
Cycle	WiSe
Content	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.
Literature	Selbst zu finden

Course L1585: Applied Statistics	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Michael Morlock
Language	DE/EN
Cycle	WiSe
Content	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).
Literature	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 M1204: Modelling and Optimization in Dynamics

Courses

Title	Typ	Hrs/wk	CP
Flexible Multibody Systems (L1632)	Lecture	2	3
Optimization of dynamical systems (L1633)	Lecture	2	3

Module Responsible	Prof. Robert Seifried
Admission Requirements	None
Recommended Previous Knowledge	• Mathematics I, II, III • Mechanics I, II, III, IV • Simulation of dynamical Systems
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students demonstrate basic knowledge and understanding of modeling, simulation and analysis of complex rigid and flexible multibody systems and methods for optimizing dynamic systems after successful completion of the module.
Skills	Students are able + to think holistically + to independently, securly and critically analyze and optimize basic problems of the dynamics of rigid and flexible multibody systems + to describe dynamics problems mathematically + to optimize dynamics problems
Personal Competence	
Social Competence	Students are able to + solve problems in heterogeneous groups and to document the corresponding results.
Autonomy	Students are able to + assess their knowledge by means of exercises. + acquaint themselves with the necessary knowledge to solve research oriented tasks.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Oral exam
Examination duration and scale	30 min
Assignment for the Following Curricula	Energy Systems: Core Qualification: Elective Compulsory Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory Product Development, Materials and Production: Core Qualification: Elective Compulsory Theoretical Mechanical Engineering: Core Qualification: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

Course L1632: Flexible Multibody Systems	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Robert Seifried, Dr. Alexander Held
Language	DE
Cycle	WiSe
Content	1. Basics of Multibody Systems 2. Basics of Continuum Mechanics 3. Linear finite element modelles and modell reduction 4. Nonlinear finite element Modelles: absolute nodal coordinate formulation 5. Kinematics of an elastic body 6. Kinetics of an elastic body 7. System assembly
Literature	Schwertassek, R. und Wallrapp, O.: Dynamik flexibler Mehrkörpersysteme. Braunschweig, Vieweg, 1999. Seifried, R.: Dynamics of Underactuated Multibody Systems, Springer, 2014. Shabana, A.A.: Dynamics of Multibody Systems. Cambridge Univ. Press, Cambridge, 2004, 3. Auflage.

Course L1633: Optimization of dynamical systems	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	WiSe
Content	1. Formulation and classification of optimization problems 2. Scalar Optimization 3. Sensitivity Analysis 4. Unconstrained Parameter Optimization 5. Constrained Parameter Optimization 6. Stochastic optimization 7. Multicriteria Optimization 8. Topology Optimization
Literature	Bestle, D.: Analyse und Optimierung von Mehrkörpersystemen. Springer, Berlin, 1994. Nocedal, J. , Wright , S.J. : Numerical Optimization. New York: Springer, 2006.

Module M0604: High-Order FEM

Courses

Title	Typ	Hrs/wk	CP
High-Order FEM (L0280)	Lecture	3	4
High-Order FEM (L0281)	Recitation Section (large)	1	2

Module Responsible	Prof. Alexander Düster
Admission Requirements	None
Recommended Previous Knowledge	Knowledge of partial differential equations is recommended.
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	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.
Skills	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.
Personal Competence	
Social Competence	Students are able to + solve problems in heterogeneous groups and to document the corresponding results.
Autonomy	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.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	**Compulsory** No; **Bonus** 10 %; **Form** Presentation; **Description** Forschendes Lernen
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	Energy Systems: Core Qualification: Elective Compulsory International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Materials Science: Specialisation Modeling: Elective Compulsory Mechanical Engineering and Management: Specialisation Product Development and Production: 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Core Qualification: Elective Compulsory

Course L0280: High-Order FEM	
Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Alexander Düster
Language	EN
Cycle	SoSe
Content	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
Literature	[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	
Typ	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Alexander Düster
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0805: Technical Acoustics I (Acoustic Waves, Noise Protection, Psycho Acoustics)

Courses

Title	Typ	Hrs/wk	CP
Technical Acoustics I (Acoustic Waves, Noise Protection, Psycho Acoustics) (L0516)	Lecture	2	3
Technical Acoustics I (Acoustic Waves, Noise Protection, Psycho Acoustics) (L0518)	Recitation Section (large)	2	3

Module Responsible	Prof. Otto von Estorff
Admission Requirements	None
Recommended Previous Knowledge	Mechanics I (Statics, Mechanics of Materials) and Mechanics II (Hydrostatics, Kinematics, Dynamics) Mathematics I, II, III (in particular differential equations)
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students possess an in-depth knowledge in acoustics regarding acoustic waves, noise protection, and psycho acoustics and are able to give an overview of the corresponding theoretical and methodical basis.
Skills	The students are capable to handle engineering problems in acoustics by theory-based application of the demanding methodologies and measurement procedures treated within the module.
Personal Competence	
Social Competence	Students can work in small groups on specific problems to arrive at joint solutions.
Autonomy	The students are able to independently solve challenging acoustical problems in the areas treated within the module. Possible conflicting issues and limitations can be identified and the results are critically scrutinized.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Energy Systems: Core Qualification: Elective Compulsory Aircraft Systems Engineering: Specialisation Cabin Systems: Elective Compulsory International Management and Engineering: Specialisation II. Aviation Systems: Elective Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Product Development, Materials and Production: Core Qualification: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory

Course L0516: Technical Acoustics I (Acoustic Waves, Noise Protection, Psycho Acoustics)

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Otto von Estorff
Language	EN
Cycle	SoSe
Content	- Introduction and Motivation - Acoustic quantities - Acoustic waves - Sound sources, sound radiation - Sound engergy and intensity - Sound propagation - Signal processing - Psycho acoustics - Noise - Measurements in acoustics
Literature	Cremer, L.; Heckl, M. (1996): Körperschall. Springer Verlag, Berlin Veit, I. (1988): Technische Akustik. Vogel-Buchverlag, Würzburg Veit, I. (1988): Flüssigkeitsschall. Vogel-Buchverlag, Würzburg

Course L0518: Technical Acoustics I (Acoustic Waves, Noise Protection, Psycho Acoustics)	
Typ	Recitation Section (large)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Otto von Estorff
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0807: Boundary Element Methods

Courses

Title	Typ	Hrs/wk	CP
Boundary Element Methods (L0523)	Lecture	2	3
Boundary Element Methods (L0524)	Recitation Section (large)	2	3

Module Responsible	Prof. Otto von Estorff
Admission Requirements	None
Recommended Previous Knowledge	Mechanics I (Statics, Mechanics of Materials) and Mechanics II (Hydrostatics, Kinematics, Dynamics) Mathematics I, II, III (in particular differential equations)
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	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.
Skills	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.
Personal Competence	
Social Competence	Students can work in small groups on specific problems to arrive at joint solutions.
Autonomy	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.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	**Compulsory** No · **Bonus** 20 % · **Form** Midterm · **Description**
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	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 Mechanical Engineering and Management: Specialisation Product Development and Production: Elective Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Product Development, Materials and Production: Core Qualification: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Theoretical Mechanical Engineering: Core Qualification: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

Course L0523: Boundary Element Methods	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Otto von Estorff
Language	EN
Cycle	SoSe
Content	- 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
Literature	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	
Typ	Recitation Section (large)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Otto von Estorff
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1164: Practical Course Product Development, Materials and Production

Courses

Title	Typ	Hrs/wk	CP
Practical Course Product Development, Materials and Production (L1566)	Practical Course	6	6

Module Responsible	Prof. Wolfgang Hintze
Admission Requirements	None
Recommended Previous Knowledge	**Product Development:** • Lectures: Mechanics I-III • Lectures: Integrated Product Development I incl. CAD practical training **Materials:** • Lectures: Structural Metallic Materials, Metallic Materials for Aircraft Applications, Introduction to Materials Testing • Lectures: Structure and Properties of Polymers, Structure and Properties of Composites, Manufacturing of Polymers and Composites **Production:** • Lecture: Production Engineering • Lectures: Forming and Cutting Technology, Methods of production process design • Lectures: Machine Tools and Robotic
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can ... • represent more complex context of different fields of study. • describe functionality of modern measurement instrumentations and machine technologies.
Skills	Students are capable of ... • applying theoretical knowledge for practical applications. • applying provided experimental methods for examining contexts of different fields of study. • analyzing and evaluating experimental results by using provided methods. • applying modern measurement instrumentations.
Personal Competence	
Social Competence	Students can ... • carry out and document experimental work in groups. • present and discuss experimental results in mixed teams of different fields of study.
Autonomy	Students are able to ... • carry out parts of experimental work independently guided by teachers. • choose and apply suitable instruments. • assess own strengths and weaknesses.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and scale	
Assignment for the Following Curricula	Biomedical Engineering: Core Qualification: Compulsory Product Development, Materials and Production: Core Qualification: Compulsory

Course L1566: Practical Course Product Development, Materials and Production	
Typ	Practical Course
Hrs/wk	6
CP	6
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Lecturer	Prof. Wolfgang Hintze, Prof. Josef Schlattmann, Prof. Dieter Krause, Prof. Claus Emmelmann, Prof. Uwe Weltin, Prof. Bodo Fiedler, Prof. Hermann Lödding, Prof. Michael Morlock, Prof. Gerold Schneider, Prof. Thorsten Schüppstuhl, Prof. Otto von Estorff, Prof. Jörg Weißmüller
Language	DE
Cycle	SoSe
Content	**Product Development**: • Modal analysis - experimental and computational • Appropriate design in engineering • Characterization of rubbery-elastic materials • Stick-Slip-Analysis at friction and wear test station **Materials**: • Property profiles of steel • Actuators for modern fuel injection systems - synthesis and properties • Processing, properties and structure of thermoplastic polymers and its composites • Tribology in joints **Production:** • Optimization of welding process parameters for hybrid plasma laser welding • Evaluation of stock removal processes • Analysis of basic laws in production logistics • Analysis of positioning behaviour and trajectory accuracy of industrial robots
Literature	Nach Themenstellung / depending on topic

Module M0752: Nonlinear Dynamics

Courses			
Title	**Typ**	**Hrs/wk**	**CP**
Nonlinear Dynamics (L0702)	Integrated Lecture	4	6

Module Responsible	Prof. Norbert Hoffmann
Admission Requirements	None
Recommended Previous Knowledge	• Calculus • Linear Algebra • Engineering Mechanics
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to reflect existing terms and concepts in Nonlinear Dynamics and to develop and research new terms and concepts.
Skills	Students are able to apply existing methods and procesures of Nonlinear Dynamics and to develop novel methods and procedures.
Personal Competence	
Social Competence	Students can reach working results also in groups.
Autonomy	Students are able to approach given research tasks individually and to identify and follow up novel research tasks by themselves.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	2 Hours
Assignment for the Following Curricula	Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective Compulsory International Management and Engineering: Specialisation II. Mechatronics: Elective Compulsory Mechanical Engineering and Management: Specialisation Mechatronics: Elective Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: 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 Product Development, Materials and Production: Core Qualification: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Core Qualification: Elective Compulsory

Course L0702: Nonlinear Dynamics

Typ	Integrated Lecture
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Norbert Hoffmann
Language	DE/EN
Cycle	SoSe
Content	Fundamentals of Nonlinear Dynamics.
Literature	S. Strogatz: Nonlinear Dynamics and Chaos. Perseus, 2013.

Module M1339: Design optimization and probabilistic approaches in structural analysis

Courses

Title	Typ	Hrs/wk	CP
Design Optimization and Probabilistic Approaches in Structural Analysis (L1873)	Lecture	2	3
Design Optimization and Probabilistic Approaches in Structural Analysis (L1874)	Recitation Section (large)	2	3

Module Responsible	Prof. Benedikt Kriegesmann
Admission Requirements	None
Recommended Previous Knowledge	• Technical mechanics • Higher math
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	

Knowledge	• Design optimization
	  ◦ Gradient based methods
	  ◦ Genetic algorithms
	  ◦ Optimization with constraints
	  ◦ Topology optimization
	• Reliability analysis
	  ◦ Stochastic basics
	  ◦ Monte Carlo methods
	  ◦ Semi-analytic approaches
	• robust design optimization
	  ◦ Robustness measures
	  ◦ Coupling of design optimization and reliability analysis

Skills	• Application of optimization algorithms and probabilistic methods in the design of structures • Programming with Matlab • Implementation of algorithms • Debugging
Personal Competence	
Social Competence	• Team work • Oral explanation of the the work
Autonomy	• Application of methods learned in the framework of a home work • Familiarizing with source code provided • Description of approaches and results
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and scale	10 pages
Assignment for the Following Curricula	Aircraft Systems Engineering: Specialisation Air Transportation Systems: Elective Compulsory Product Development, Materials and Production: Core Qualification: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Core Qualification: Elective Compulsory

Course L1873: Design Optimization and Probabilistic Approaches in Structural Analysis	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	SoSe

Content	In the course the theoretic basics for design optimization and reliability analysis are taught, where the focus is on the application of such methods. The lectures will consist of presentations as well as computer exercises. In the computer exercises, the methods learned will be implemented in Matlab for understanding the practical realization.
	
	The following contents will be considered:
	
	• Design optimization
	    ◦ Gradient based methods
	    ◦ Genetic algorithms
	    ◦ Optimization with constraints
	    ◦ Topology optimization
	• Reliability analysis
	    ◦ Stochastic basics
	    ◦ Monte Carlo methods
	    ◦ Semi-analytic approaches
	• robust design optimization
	    ◦ Robustness measures
	    ◦ Coupling of design optimization and reliability analysis

Literature	[1] Arora, Jasbir. Introduction to Optimum Design. 3rd ed. Boston, MA: Academic Press, 2011. [2] Haldar, A., and S. Mahadevan. Probability, Reliability, and Statistical Methods in Engineering Design. John Wiley & Sons New York/Chichester, UK, 2000.

Course L1874: Design Optimization and Probabilistic Approaches in Structural Analysis	
Typ	Recitation Section (large)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	SoSe
Content	Matlab exercises complementing the lecture
Literature	siehe Vorlesung

Module M0806: Technical Acoustics II (Room Acoustics, Computational Methods)

Courses

Title	Typ	Hrs/wk	CP
Technical Acoustics II (Room Acoustics, Computational Methods) (L0519)	Lecture	2	3
Technical Acoustics II (Room Acoustics, Computational Methods) (L0521)	Recitation Section (large)	2	3

Module Responsible	Prof. Otto von Estorff
Admission Requirements	None
Recommended Previous Knowledge	Technical Acoustics I (Acoustic Waves, Noise Protection, Psycho Acoustics) Mechanics I (Statics, Mechanics of Materials) and Mechanics II (Hydrostatics, Kinematics, Dynamics) Mathematics I, II, III (in particular differential equations)
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students possess an in-depth knowledge in acoustics regarding room acoustics and computational methods and are able to give an overview of the corresponding theoretical and methodical basis.
Skills	The students are capable to handle engineering problems in acoustics by theory-based application of the demanding computational methods and procedures treated within the module.
Personal Competence	
Social Competence	Students can work in small groups on specific problems to arrive at joint solutions.
Autonomy	The students are able to independently solve challenging acoustical problems in the areas treated within the module. Possible conflicting issues and limitations can be identified and the results are critically scrutinized.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Oral exam
Examination duration and scale	20-30 Minuten
Assignment for the Following Curricula	Aircraft Systems Engineering: Specialisation Cabin Systems: Elective Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Product Development, Materials and Production: Core Qualification: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory

Course L0519: Technical Acoustics II (Room Acoustics, Computational Methods)

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Otto von Estorff
Language	EN
Cycle	WiSe
Content	- Room acoustics - Sound absorber - Standard computations - Statistical Energy Approaches - Finite Element Methods - Boundary Element Methods - Geometrical acoustics - Special formulations - Practical applications - Hands-on Sessions: Programming of elements (Matlab)
Literature	Cremer, L.; Heckl, M. (1996): Körperschall. Springer Verlag, Berlin Veit, I. (1988): Technische Akustik. Vogel-Buchverlag, Würzburg Veit, I. (1988): Flüssigkeitsschall. Vogel-Buchverlag, Würzburg 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 L0521: Technical Acoustics II (Room Acoustics, Computational Methods)	
Typ	Recitation Section (large)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Otto von Estorff
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1140: Technical Complementary Course Core Studies for PEPMS (according to Subject Specific Regulations)

Courses

Title	Typ	Hrs/wk	CP

Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous Knowledge	See selected module according to FSPO
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	see selected module according to FSPO
Skills	see selected module according to FSPO
Personal Competence	
Social Competence	see selected module according to FSPO
Autonomy	see selected module according to FSPO
Workload in Hours	Depends on choice of courses
Credit points	6
Assignment for the Following Curricula	Product Development, Materials and Production: Core Qualification: Elective Compulsory

Module M1184: Research Project Product Development, Materials and Production

Courses			
Title	**Typ**	**Hrs/wk**	**CP**

Module Responsible	Dozenten des Studiengangs
Admission Requirements	None
Recommended Previous Knowledge	Subjects of the Master program and the chosen specialisation.
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students can explain the project as well as their autonomously gained knowledge and relate it to current issues of their field of study. • They can explain the basic scientific methods they have worked with.
Skills	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.
Personal Competence	
Social Competence	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.
Autonomy	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.
Workload in Hours	Independent Study Time 360, Study Time in Lecture 0
Credit points	12
Course achievement	None
Examination	Study work
Examination duration and scale	according to FSPO
Assignment for the Following Curricula	Product Development, Materials and Production: Core Qualification: Compulsory

Specialization Product Development

In the product development specialization, graduates learn to work systematically and methodically on challenging design tasks. They have a wide knowledge of new development methods, are able to select appropriate solution strategies and use these autonomously to develop new products. They are qualified to use the approaches of integrated product development, such as simulation or modern testing procedures, for example for the development of lightweight products. With their additional knowledge about modern high-performance materials and production processes graduates can design products on the cutting edge of technology, calculate and actively promote the development of products using modern methods.

Module M0763: Aircraft Systems I

Courses

Title	Typ	Hrs/wk	CP
Aircraft Systems I (L0735)	Lecture	3	4
Aircraft Systems I (L0739)	Recitation Section (large)	2	2

Module Responsible	Prof. Frank Thielecke
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Electrical Engineering • Hydraulics • Control Systems
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to: • Describe essential components and design points of hydraulic, electrical and high-lift systems • Give an overview of the functionality of air conditioning systems • Explain the need for high-lift systems such as ist functionality and effects • Assess the challenge during the design of supply systems of an aircraft
Skills	Students are able to: • Design hydraulic and electric supply systems of aircrafts • Design high-lift systems of aircrafts • Analyze the thermodynamic behaviour of air conditioning systems
Personal Competence	
Social Competence	Students are able to: • Perform system design in groups and present and discuss results
Autonomy	Students are able to: • Reflect the contents of lectures autonomously
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	165 Minutes
Assignment for the Following Curricula	Energy Systems: Specialisation Energy Systems: Elective Compulsory Aircraft Systems Engineering: Core Qualification: Compulsory International Management and Engineering: Specialisation II. Aviation Systems: 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory

Course L0735: Aircraft Systems I	
Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	WiSe
Content	• Hydraulic Energy Systems (Fluids; pressure loss in valves and pipes; components of hydraulic systems like pumps, valves, etc.; pressure/flow characteristics; actuators; tanks; power and heat balances; emergency power) • Electric Energy Systems (Generators; constant-speed-drives; DC and AC converters; electrical power distribution; bus systems; monitoring; load analysis) • High Lift Systems (Principles; investigation of loads and system actuation power; principles and sizing of actuation and positioning systems; safety requirements and devices) • Environmental Control Systems (Thermodynamic analysis; expansion and compression cooling systems; control strategies; cabin pressure control systems)
Literature	• Moir, Seabridge: Aircraft Systems • Green: Aircraft Hydraulic Systems • Torenbek: Synthesis of Subsonic Airplane Design • SAE1991: ARP; Air Conditioning Systems for Subsonic Airplanes

Course L0739: Aircraft Systems I	
Typ	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1024: Methods of Integrated Product Development

Courses

Title	Typ	Hrs/wk	CP
Integrated Product Development II (L1254)	Lecture	3	3
Integrated Product Development II (L1255)	Project-/problem-based Learning	2	3

Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge of Integrated product development and applying CAE systems
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	After passing the module students are able to: • explain technical terms of design methodology, • describe essential elements of construction management, • describe current problems and the current state of research of integrated product development.
Skills	After passing the module students are able to: • select and apply proper construction methods for non-standardized solutions of problems as well as adapt new boundary conditions, • solve product development problems with the assistance of a workshop based approach, • choose and execute appropriate moderation techniques.
Personal Competence	
Social Competence	After passing the module students are able to: • prepare and lead team meetings and moderation processes, • work in teams on complex tasks, • represent problems and solutions and advance ideas.
Autonomy	After passing the module students are able to: • give a structured feedback and accept a critical feedback, • implement the accepted feedback autonomous.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Oral exam
Examination duration and scale	30 Minuten
Assignment for the Following Curricula	Aircraft Systems Engineering: Specialisation Cabin Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Air Transportation Systems: Elective Compulsory International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory

Course L1254: Integrated Product Development II	
Typ	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	**Lecture** The lecture extends and enhances the learned content of the module “Integrated Product Development and lightweight design” and is based on the knowledge and skills acquired there. Topics of the course include in particular: • Methods of product development, • Presentation techniques, • Industrial Design, • Design for variety • Modularization methods, • Design catalogs, • Adapted QFD matrix, • Systematic material selection, • Assembly oriented design, Construction management • CE mark, declaration of conformity including risk assessment, • Patents, patent rights, patent monitoring • Project management (cost, time, quality) and escalation principles, • Development management for mechatronics, • Technical Supply Chain Management. **Exercise (PBL)** In the exercise the content presented in the lecture “Integrated Product Development II” and methods of product development and design management will be enhanced. Students learn an independently moderated and workshop based approach through industry related practice examples to solve complex and currently existing issues in product development. They will learn the ability to apply important methods of product development and design management autonomous and acquire further expertise in the field of integrated product development. Besides personal skills, such as teamwork, guiding discussions and representing work results will be acquired through the workshop based structure of the event under its own planning and management.
Literature	• Andreasen, M.M., Design for Assembly, Berlin, Springer 1985. • Ashby, M. F.: Materials Selection in Mechanical Design, München, Spektrum 2007. • Beckmann, H.: Supply Chain Management, Berlin, Springer 2004. • Hartmann, M., Rieger, M., Funk, R., Rath, U.: Zielgerichtet moderieren. Ein Handbuch für Führungskräfte, Berater und Trainer, Weinheim, Beltz 2007. • Pahl, G., Beitz, W.: Konstruktionslehre, Berlin, Springer 2006. • Roth, K.H.: Konstruieren mit Konstruktionskatalogen, Band 1-3, Berlin, Springer 2000. • Simpson, T.W., Siddique, Z., Jiao, R.J.: Product Platform and Product Family Design. Methods and Applications, New York, Springer 2013.

Course L1255: Integrated Product Development II	
Typ	Project-/problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1025: Fluidics

Courses			
Title	**Typ**	**Hrs/wk**	**CP**
Fluidics (L1256)	Lecture	2	3
Fluidics (L1371)	Project-/problem-based Learning	1	2
Fluidics (L1257)	Recitation Section (large)	1	1

Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous Knowledge	Good knowledge of mechanics (stereo statics, elastostatics, hydrostatics, kinematics and kinetics), fluid mechanics, and engineering design
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	After passing the module students are able to • explain structures and functionalities of hydrostatic, pneumatic, and hydrodynamic components, • explain the interaction of hydraulic components in hydraulic systems, • explain open and closed loop control of hydraulic systems, • describe functioning and applications of hydrodynamic torque converters, brakes and clutches as well as centrifugal pumps and aggregates in plant technology
Skills	After passing the module students are able to • analyse and assess hydraulic and pneumatic components and systems, • design and dimension hydraulic systems for mechanical applications, • perform numerical simulations of hydraulic systems based on abstract problem definitions, • select and adapt pump characteristic curves for hydraulic systems • dimension hydrodynamic torque converters and brakes for mechanical aggregates.
Personal Competence	
Social Competence	After passing the module students are able to • discuss and present functional context in groups, • organise teamwork autonomously.
Autonomy	After passing the module students are able to • obtain necessary knowledge for the simulation.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	**Compulsory** / **Bonus** / **Form** / **Description** Yes / None / Attestation / Simulation hydrostatischer Systeme
Examination	Written exam
Examination duration and scale	90
Assignment for the Following Curricula	International Management and Engineering: Specialisation II. Mechatronics: Elective Compulsory International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: 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 L1256: Fluidics	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	**Lecture** Hydrostatics • physical fundamentals • hydraulic fluids • hydrostatic machines • valves • components • hydrostatic transmissions • examples from industry Pneumatics • generation of compressed air • pneumatic motors • Examples of use Hydrodynamics • physical fundamentals • hydraulic continous-flow machines • hydrodynamic transmissions • interoperation of motor and transmission **Exercise** Hydrostatics • reading and design of hydraulic diagrams • dimensioning of hydrostatic traction and working drives • performance calculation Hydrodynamics • calculation / dimensioning of hydrodynamic torque converters • calculation / dimensioning of centrifugal pumps • creating and reading of characteristic curves of pumps and systems Field trip • field trip to a regional company from the hydraulic industry. **Exercise** Numerical simulation of hydrostatic systems • getting to know a numerical simulation environment for hydraulic systems • transformation of a task into a simulation model • simulation of common components • variation of simulation parameters • using simulations for system dimensioning and optimisation • (partly) self-organised teamwork
Literature	Bücher • Murrenhoff, H.: Grundlagen der Fluidtechnik - Teil 1: Hydraulik, Shaker Verlag, Aachen, 2011 • Murrenhoff, H.: Grundlagen der Fluidtechnik - Teil 2: Pneumatik, Shaker Verlag, Aachen, 2006 • Matthies, H.J. Renius, K.Th.: Einführung in die Ölhydraulik, Teubner Verlag, 2006 • Beitz, W., Grote, K.-H.: Dubbel - Taschenbuch für den Maschinenbau, Springer-Verlag, Berlin, aktuelle Auflage Skript zur Vorlesung

Course L1371: Fluidics	
Typ	Project-/problem-based Learning
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1257: Fluidics	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1193: Cabin Systems Engineering

Courses

Title	Typ	Hrs/wk	CP
Computer and communication technology in cabin electronics and avionics (L1557)	Lecture	2	2
Computer and communication technology in cabin electronics and avionics (L1558)	Recitation Section (small)	1	1
Model-Based Systems Engineering (MBSE) with SysML/UML (L1551)	Project-/problem-based Learning	3	3

Module Responsible	Prof. Ralf God
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Electrical Engineering • Control Systems Previous knowledge in: • Systems Engineering
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to: • describe the structure and operation of computer architectures • explain the structure and operation of digital communication Networks • explain architectures of cabin electronics, integrated modular avionics (IMA) and Aircraft Data Communication Network (ADCN) • understand the approach of Model-Based Systems Engineering (MBSE) in the design of hardware and software-based cabin systems
Skills	Students are able to: • understand, operate and maintain a Minicomputer • build up a network communication and communicate with other network participants • connect a minicomputer with a cabin management system (A380 CIDS) and communicate over a AFDX®-Network • model system functions by means of formal languages SysML/UML and generate software code from the models • execute software code on a minicomputer
Personal Competence	
Social Competence	Students are able to: • elaborate partial results and merge with others to form a complete solution
Autonomy	Students are able to: • organize and schedule their practical tasks
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 minutes
Assignment for the Following Curricula	Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Air Transportation Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Cabin Systems: Compulsory International Management and Engineering: Specialisation II. Aviation Systems: 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory

Course L1557: Computer and communication technology in cabin electronics and avionics	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf God
Language	DE
Cycle	WiSe
Content	The objective of the lecture with the corresponding exercise is the acquisition of knowledge of computer and communication technology in electronic systems in the cabin and in aircraft. For the system engineer the strong interaction of software, mechanical and electronic system components nowadays requires a basic understanding of cabin electronics and avionics. The course teaches the basics of design and functionality of computers and data networks. Subsequently it focuses on current principles and applications in integrated modular avionics (IMA), aircraft data communication networks (ADCN), cabin electronics and cabin networks: • History of computer and network technology • Layer model in computer technology • Computer architectures (PC, IPC, Embedded Systems) • BIOS, UEFI and operating system (OS) • Programming languages (machine code and high-level languages) • Applications and Application Programming Interfaces • External interfaces (serial, USB, Ethernet) • Layer model in network technology • Network topologies • Network components • Bus access procedures • Integrated Modular Avionics (IMA) and Aircraft Data Communication Networks (ADCN) • Cabin electronics and cabin networks
Literature	- Skript zur Vorlesung - Schnabel, P.: Computertechnik-Fibel: Grundlagen Computertechnik, Mikroprozessortechnik, Halbleiterspeicher, Schnittstellen und Peripherie. Books on Demand; 1. Auflage, 2003 - Schnabel, P.: Netzwerktechnik-Fibel: Grundlagen, Übertragungstechnik und Protokolle, Anwendungen und Dienste, Sicherheit. Books on Demand; 1. Auflage, 2004 - Wüst, K.: Mikroprozessortechnik: Grundlagen, Architekturen und Programmierung von Mikroprozessoren, Mikrocontrollern und Signalprozessoren. Vieweg Verlag; 2. aktualisierte und erweiterte Auflage, 2006

Course L1558: Computer and communication technology in cabin electronics and avionics	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Ralf God
Language	DE
Cycle	WiSe
Content	The objective of the lecture with the corresponding exercise is the acquisition of knowledge of computer and communication technology in electronic systems in the cabin and in aircraft. For the system engineer the strong interaction of software, mechanical and electronic system components nowadays requires a basic understanding of cabin electronics and avionics. The course teaches the basics of design and functionality of computers and data networks. Subsequently it focuses on current principles and applications in integrated modular avionics (IMA), aircraft data communication networks (ADCN), cabin electronics and cabin networks: • History of computer and network technology • Layer model in computer technology • Computer architectures (PC, IPC, Embedded Systems) • BIOS, UEFI and operating system (OS) • Programming languages (machine code and high-level languages) • Applications and Application Programming Interfaces • External interfaces (serial, USB, Ethernet) • Layer model in network technology • Network topologies • Network components • Bus access procedures • Integrated Modular Avionics (IMA) and Aircraft Data Communication Networks (ADCN) • Cabin electronics and cabin networks
Literature	- Skript zur Vorlesung - Schnabel, P.: Computertechnik-Fibel: Grundlagen Computertechnik, Mikroprozessortechnik, Halbleiterspeicher, Schnittstellen und Peripherie. Books on Demand; 1. Auflage, 2003 - Schnabel, P.: Netzwerktechnik-Fibel: Grundlagen, Übertragungstechnik und Protokolle, Anwendungen und Dienste, Sicherheit. Books on Demand; 1. Auflage, 2004 - Wüst, K.: Mikroprozessortechnik: Grundlagen, Architekturen und Programmierung von Mikroprozessoren, Mikrocontrollern und Signalprozessoren. Vieweg Verlag; 2. aktualisierte und erweiterte Auflage, 2006

Course L1551: Model-Based Systems Engineering (MBSE) with SysML/UML	
Typ	Project-/problem-based Learning
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Ralf God, Dr. Sylvia Melzer
Language	DE
Cycle	SoSe
Content	Objectives of the problem-oriented course are the acquisition of knowledge on system design using the formal languages SysML/UML, learning about tools for modeling and finally the implementation of a project with methods and tools of Model-Based Systems Engineering (MBSE) on a realistic hardware platform (e.g. Arduino®, Raspberry Pi®): • What is a model? • What is Systems Engineering? • Survey of MBSE methodologies • The modelling languages SysML /UML • Tools for MBSE • Best practices for MBSE • Requirements specification, functional architecture, specification of a solution • From model to software code • Validation and verification: XiL methods • Accompanying MBSE project
Literature	- Skript zur Vorlesung - Weilkiens, T.: Systems Engineering mit SysML/UML: Modellierung, Analyse, Design. 2. Auflage, dpunkt.Verlag, 2008 - Holt, J., Perry, S.A., Brownsword, M.: Model-Based Requirements Engineering. Institution Engineering & Tech, 2011

Module M0511: Electricity Generation from Wind and Hydro Power

Courses

Title	Typ	Hrs/wk	CP
Renewable Energy Projects in Emerged Markets (L0014)	Project Seminar	1	1
Hydro Power Use (L0013)	Lecture	1	1
Wind Turbine Plants (L0011)	Lecture	2	3
Wind Energy Use - Focus Offshore (L0012)	Lecture	1	1

Module Responsible	Dr. Joachim Gerth
Admission Requirements	None
Recommended Previous Knowledge	Module: Technical Thermodynamics I, Module: Technical Thermodynamics II, Module: Fundamentals of Fluid Mechanics
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	By ending this module students can explain in detail knowledge of wind turbines with a particular focus of wind energy use in offshore conditions and can critical comment these aspects in consideration of current developments. Furthermore, they are able to describe fundamentally the use of water power to generate electricity. The students reproduce and explain the basic procedure in the implementation of renewable energy projects in countries outside Europe. Through active discussions of various topics within the seminar of the module, students improve their understanding and the application of the theoretical background and are thus able to transfer what they have learned in practice.
Skills	Students are able to apply the acquired theoretical foundations on exemplary water or wind power systems and evaluate and assess technically the resulting relationships in the context of dimensioning and operation of these energy systems. They can in compare critically the special procedure for the implementation of renewable energy projects in countries outside Europe with the in principle applied approach in Europe and can apply this procedure on exemplary theoretical projects.
Personal Competence	
Social Competence	Students can discuss scientific tasks subjet-specificly and multidisciplinary within a seminar.
Autonomy	Students can independently exploit sources in the context of the emphasis of the lecture material to clear the contents of the lecture and to acquire the particular knowledge about the subject area.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	3 hours written exam
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Energy and Environmental Engineering: Specialisation Energy Engineering: Elective Compulsory International Management and Engineering: Specialisation II. Renewable Energy: Elective Compulsory International Management and Engineering: Specialisation II. Energy and Environmental Engineering: 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 Renewable Energies: Core Qualification: Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory Water and Environmental Engineering: Specialisation Environment: Compulsory Water and Environmental Engineering: Specialisation Cities: Elective Compulsory

Course L0014: Renewable Energy Projects in Emerged Markets	
Typ	Project Seminar
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Andreas Wiese
Language	DE
Cycle	SoSe
Content	1. Introduction ◦ Development of renewable energies worldwide ▪ History ▪ Future markets ◦ Special challenges in new markets - Overview 2. Sample project wind farm Korea ◦ Survey ◦ Technical Description ◦ Project phases and characteristics 3. Funding and financing instruments for EE projects in new markets ◦ Overview funding opportunitie ◦ Overview countries with feed-in laws ◦ Major funding programs 4. CDM projects - why, how , examples ◦ Overview CDM process ◦ Examples ◦ Exercise CDM 5. Rural electrification and hybrid systems - an important future market for EE ◦ Rural Electrification - Introduction ◦ Types of Elektrizifierungsprojekten ◦ The role of the EEInterpretation of hybrid systems ◦ Project example: hybrid system Galapagos Islands 6. Tendering process for EE projects - examples ◦ South Africa ◦ Brazil 7. Selected projects from the perspective of a development bank - Wesley Urena Vargas, KfW Development Bank ◦ Geothermal ◦ Wind or CSP Within the seminar, the various topics are actively discussed and applied to various cases of application.
Literature	Folien der Vorlesung

Course L0013: Hydro Power Use	
Typ	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Stefan Achleitner
Language	DE
Cycle	SoSe
Content	• Introduction, importance of water power in the national and global context • Physical basics: Bernoulli's equation, usable height of fall, hydrological measures, loss mechanisms, efficiencies • Classification of Hydropower: Flow and Storage hydropower, low and high pressure systems • Construction of hydroelectric power plants: description of the individual components and their technical system interaction • Structural engineering components; representation of dams, weirs, dams, power houses, computer systems, etc. • Energy Technical Components: Illustration of the different types of hydraulic machinery, generators and grid connection • Hydropower and the Environment • Examples from practice
Literature	• Schröder, W.; Euler, G.; Schneider, K.: Grundlagen des Wasserbaus; Werner, Düsseldorf, 1999, 4. Auflage • Quaschning, V.: Regenerative Energiesysteme: Technologie - Berechnung - Simulation; Carl Hanser, München, 2011, 7. Auflage • Giesecke, J.; Heimerl, S.; Mosony, E.: Wasserkraftanlagen - Planung, Bau und Betrieb; Springer, Berlin, Heidelberg, 2009, 5. Auflage • von König, F.; Jehle, C.: Bau von Wasserkraftanlagen - Praxisbezogene Planungsunterlagen; C. F. Müller, Heidelberg, 2005, 4. Auflage • Strobl, T.; Zunic, F.: Wasserbau: Aktuelle Grundlagen - Neue Entwicklungen; Springer, Berlin, Heidelberg, 2006

Course L0011: Wind Turbine Plants	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Rudolf Zellermann, Dr. Jochen Oexmann
Language	DE
Cycle	SoSe
Content	• Historical development • Wind: origins, geographic and temporal distribution, locations • Power coefficient, rotor thrust • Aerodynamics of the rotor • Operating performance • Power limitation, partial load, pitch and stall control • Plant selection, yield prediction, economy • Excursion
Literature	Gasch, R., Windkraftanlagen, 4. Auflage, Teubner-Verlag, 2005

Course L0012: Wind Energy Use - Focus Offshore	
Typ	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Martin Skiba
Language	DE
Cycle	SoSe
Content	• Introduction, importance of offshore wind power generation, Specific requirements for offshore engineering • Physical fundamentals for utilization of wind energy • Design and operation of offshore wind turbines, presentation of different concepts of offshore wind turbines, representation of the individual system components and their system-technical relationships • Foundation engineering, offshore site investigation, presentation of different concepts of offshore foundation structures, planning and fabrication of foundation structures • Electrical infrastructure of an offshore wind farm, Inner Park cabling, offshore substation, grid connection • Installation of offshore wind farms, installation techniques and auxiliary devices, construction logistics • Development and planning of offshore wind farms • Operation and optimization of offshore wind farms • Day excursion
Literature	• Gasch, R.; Twele, J.: Windkraftanlagen - Grundlagen, Entwurf, Planung und Betrieb; Vieweg + Teubner, Stuttgart, 2007, 7. Auflage • Molly, J. P.: Windenergie - Theorie, Anwendung, Messung; C. F. Müller, Heidel-berg, 1997, 3. Auflage • Hau, E.: Windkraftanalagen; Springer, Berlin, Heidelberg, 2008, 4.Auflage • Heier, S.: Windkraftanlagen - Systemauslegung, Integration und Regelung; Vieweg + Teubner, Stuttgart, 2009, 5. Auflage • Jarass, L.; Obermair, G.M.; Voigt, W.: Windenergie: Zuverlässige Integration in die Energieversorgung; Springer, Berlin, Heidelberg, 2009, 2. Auflage

Module M0630: Robotics and Navigation in Medicine

Courses			
Title	**Typ**	**Hrs/wk**	**CP**
Robotics and Navigation in Medicine (L0335)	Lecture	2	3
Robotics and Navigation in Medicine (L0338)	Project Seminar	2	2
Robotics and Navigation in Medicine (L0336)	Recitation Section (small)	1	1

Module Responsible	Prof. Alexander Schlaefer
Admission Requirements	None
Recommended Previous Knowledge	• principles of math (algebra, analysis/calculus) • principles of programming, e.g., in Java or C++ • solid R or Matlab skills
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students can explain kinematics and tracking systems in clinical contexts and illustrate systems and their components in detail. Systems can be evaluated with respect to collision detection and safety and regulations. Students can assess typical systems regarding design and limitations.
Skills	The students are able to design and evaluate navigation systems and robotic systems for medical applications.
Personal Competence	
Social Competence	The students discuss the results of other groups, provide helpful feedback and can incoorporate feedback into their work.
Autonomy	The students can reflect their knowledge and document the results of their work. They can present the results in an appropriate manner.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	**Compulsory** / **Bonus** / **Form** / **Description** Yes / 10 % / Written elaboration Yes / 10 % / Presentation
Examination	Written exam
Examination duration and scale	90 minutes
Assignment for the Following Curricula	Computer Science: Specialisation Intelligence Engineering: Elective Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory International Management and Engineering: Specialisation II. Electrical Engineering: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: 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 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Bio- and Medical Technology: Elective Compulsory

Course L0335: Robotics and Navigation in Medicine

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Alexander Schlaefer
Language	EN
Cycle	SoSe
Content	- kinematics - calibration - tracking systems - navigation and image guidance - motion compensation The seminar extends and complements the contents of the lecture with respect to recent research results.
Literature	Spong et al.: Robot Modeling and Control, 2005 Troccaz: Medical Robotics, 2012 Further literature will be given in the lecture.

Course L0338: Robotics and Navigation in Medicine	
Typ	Project Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Alexander Schlaefer
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0336: Robotics and Navigation in Medicine	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Alexander Schlaefer
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0764: Aircraft Systems II

Courses			
Title	**Typ**	**Hrs/wk**	**CP**
Aircraft Systems II (L0736)	Lecture	3	4
Aircraft Systems II (L0740)	Recitation Section (large)	2	2

Module Responsible	Prof. Frank Thielecke
Admission Requirements	None
Recommended Previous Knowledge	basic knowledge of: • mathematics • mechanics • thermo dynamics • electronics • fluid technology • control technology
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to... • describe the structure of primary flight control systems as well as actuation-, avionic-, fuel- and landing gear-systems in general along with corresponding properties and applications. • explain different configurations and designs and their origins • explain atmospheric conditions for icing such as the functionality of anti-ice systems
Skills	Students are able to... • size primary flight control actuation systems • perform a controller design process for the flight control actuators • design high-lift kinematics • design and analyse landing gear systems • design anti-ice systems
Personal Competence	
Social Competence	Students are able to: • Develop joint solutions in mixed teams
Autonomy	Students are able to: • derive requirements and perform appropriate yet simplified design processes for aircraft systems from complex issues and circumstances in a self-reliant manner
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	165 Minutes
Assignment for the Following Curricula	Aircraft Systems Engineering: Core Qualification: Compulsory International Management and Engineering: Specialisation II. Aviation Systems: 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory

Course L0736: Aircraft Systems II	
Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	SoSe
Content	• Actuation (Principles of actuators; electro-mechanical actuators; modeling, analysis and sizing of position control systems; hydro-mechanic actuation systems) • Flight Control Systems (control surfaces, hinge moments; requirements of stability and controllability, actuation power; principles of reversible and irreversible flight control systems; servo actuation systems) • Landing Gear Systems (Configurations and geometries; analysis of landing gear systems with respect to damper dynamics, dynamics of the breaking aircraft and power consumption; design and analysis of breaking systems with respect to energy and heat; anti-skit systems) • Fuel Systems (Architectures; aviation fuels; system components; fueling system; tank inerting system; fuel management; trim tank) • De- and Anti-Ice Systems: (Atmospheric icing conditions; principles of de- and anti-ice systems)
Literature	• Moir, Seabridge: Aircraft Systems • Torenbek: Synthesis of Subsonic Airplane Design • Curry: Aircraft Landing Gear Design: Principles and Practices

Course L0740: Aircraft Systems II	
Typ	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0811: Medical Imaging Systems

Courses			
Title	**Typ**	**Hrs/wk**	**CP**
Medical Imaging Systems (L0819)	Lecture	4	6

Module Responsible	Dr. Michael Grass
Admission Requirements	None
Recommended Previous Knowledge	none
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can: • Describe the system configuration and components of the main clinical imaging systems; • Explain how the system components and the overall system of the imaging systems function; • Explain and apply the physical processes that make imaging possible and use with the fundamental physical equations; • Name and describe the physical effects required to generate image contrasts; • Explain how spatial and temporal resolution can be influenced and how to characterize the images generated; • Explain which image reconstruction methods are used to generate images; Describe and explain the main clinical uses of the different systems.

Skills	Students are able to:
	• Explain the physical processes of images and assign to the systems the basic mathematical or physical equations required;
	  ◦ Calculate the parameters of imaging systems using the mathematical or physical equations;
	  ◦ Determine the influence of different system components on the spatial and temporal resolution of imaging systems;
	  ◦ Explain the importance of different imaging systems for a number of clinical applications;
	Select a suitable imaging system for an application.

Personal Competence	
Social Competence	none
Autonomy	Students can: • Understand which physical effects are used in medical imaging; • Decide independently for which clinical issue a measuring system can be used.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Biomedical Engineering: 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Bio- and Medical Technology: Elective Compulsory

Course L0819: Medical Imaging Systems

Typ	Lecture
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Dr. Michael Grass, Dr. Tim Nielsen, Dr. Sven Prevrhal, Frank Michael Weber
Language	DE
Cycle	SoSe
Content	
Literature	Primary book: 1. P. Suetens, "Fundamentals of Medical Imaging", Cambridge Press Secondary books: - A. Webb, "Introduction to Biomedical Imaging", IEEE Press 2003. - W.R. Hendee and E.R. Ritenour, "Medical Imaging Physics", Wiley-Liss, New York, 2002. - H. Morneburg (Edt), "Bildgebende Systeme für die medizinische Diagnostik", Erlangen: Siemens Publicis MCD Verlag, 1995. - O. Dössel, "Bildgebende Verfahren in der Medizin", Springer Verlag Berlin, 2000.

Module M1141: Selected Topics of Product Development, Materials Science and Production (Alternative A: 12 LP)

Courses

Title	Typ	Hrs/wk	CP
Applied Automation (L1592)	Project-/problem-based Learning	3	3
Ergonomics (L0653)	Lecture	2	3
Elements of Integrated Production Systems (L0927)	Project-/problem-based Learning	2	3
Emotional Design / User Centered Product Development (L1703)	Seminar	2	2
Development Management for Mechatronics (L1512)	Lecture	2	3
Fatigue & Damage Tolerance (L0310)	Lecture	2	3
Industry 4.0 for engineers (L2012)	Lecture	2	3
Innovation and Product Management (L2168)	Seminar	2	3
Lightweight Construction with Fibre Reinforced Rolymers - Structural Mechanics (L1514)	Lecture	2	3
Lightweight Design Practical Course (L1258)	Project-/problem-based Learning	3	3
Mechanisms, Systems and Processes of Materials Testing (L0950)	Lecture	2	2
Microsystems Technology (L0724)	Lecture	2	4
Productivity Management (L0928)	Project-/problem-based Learning	2	2
Productivity Management (L0931)	Recitation Section (small)	1	1
Feedback Control in Medical Technology (L0664)	Lecture	2	3
Renewable Energy (L0313)	Lecture	2	2
Renewable Energy (L1434)	Recitation Section (small)	1	1
Six Sigma (L1130)	Lecture	2	3
System Simulation (L1820)	Lecture	2	2
System Simulation (L1821)	Recitation Section (large)	1	2
Technical Design (L1513)	Lecture	2	3
Ceramics Technology (L0379)	Lecture	2	3
Materials Testing (L0949)	Lecture	2	2
Reliability in Engineering Dynamics (L0176)	Lecture	2	2
Reliability in Engineering Dynamics (L1303)	Recitation Section (small)	1	2
Reliability of Aircraft Systems (L0749)	Lecture	2	3

Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous Knowledge	None
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students are able to express their extended knowledge and discuss the connection of different special fields or application areas of product development, materials and production • Students are qualified to connect different special fields with each other
Skills	• Students can apply specialized solution strategies and new scientific methods in selected areas • Students are able to transfer learned skills to new and unknown problems and can develop own solution approaches
Personal Competence	
Social Competence	-
Autonomy	• Students are able to develop their knowledge and skills by autonomous election of courses.
Workload in Hours	Depends on choice of courses
Credit points	12
Assignment for the Following Curricula	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

Course L1592: Applied Automation	
Typ	Project-/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 Minuten
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	-Project Based Learning -Robot Operating System -Robot structure and description -Motion description -Calibration -Accuracy
Literature	John J. Craig Introduction to Robotics – Mechanics and Control ISBN: 0131236296 Pearson Education, Inc., 2005 Stefan Hesse Grundlagen der Handhabungstechnik ISBN: 3446418725 München Hanser, 2010 K. Thulasiraman and M. N. S. Swamy Graphs: Theory and Algorithms ISBN: 9781118033104 John Wüey & Sons, Inc., 1992

Course L0653: Ergonomics	
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	30 Minuten
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	

Course L0927: Elements of Integrated Production Systems	
Typ	Project-/problem-based Learning
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. Hermann Lödding
Language	DE
Cycle	SoSe
Content	not available
Literature	Harris, R.; Harris, C.; Wilson, E.: Making Materials Flow, Lean Enterprise Institute, Cambridge, 2003. Ohno, T.: Das Toyota-Produktionssystem, Campus-Verlag, Frankfurt et al, 1993. Rother, M.: Die Kata des Weltmarktführers. Toyotas Erfolgsmethoden, Campus-Verlag, Frankfurt et al, 2009. Rother, M.; Shook, J.: Sehen lernen: Mit Wertstromdesign die Wertschöpfung erhöhen und Verschwendung beseitigen, Lean Management Institut, Aachen, 2006. Rother, M.; Harris, R.: Creating Continuous Flow, Lean Enterprise Institute, Brookline, 2001. Shingo, S.: A Revolution in Manufacturing. The SMED System, Productivity Press, 2006. Womack, J. P. et al: Die zweite Revolution in der Autoindustrie, Frankfurt/New York, Campus Verlag, 1992.

Course L1703: Emotional Design / User Centered Product Development	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	Teamarbeit und abschließender Vortrag
Lecturer	Jörg Heuser
Language	DE
Cycle	SoSe
Content	Lecture • Objective and subjective perception for the evaluation of product characteristics • Effects of material, color, shape and structure to the acceptance of a product • Aesthetic function of a product • Case studies, lack of acceptance of a product and possible reason Seminar • Identification of non-technical product functions • Identification of subjective influences for the product development Project Work • Topics will be developed in cooperation with the students. Project works will be presented in teams, presented and evaluated Exemplary Project: Holistic product evaluation, product optimization
Literature	Wird in der Veranstaltung angegeben

Course L1512: Development Management for Mechatronics	
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	30 Minuten
Lecturer	Dr. Daniel Steffen
Language	DE
Cycle	SoSe
Content	• Processes and methods of product development - from idea to market launch ◦ identification of market and technology potentials ◦ development of a common product architecture ◦ Synchronized product development across all engineering disciplines ◦ product validation incl. customer view • Steering and optimization of product development ◦ Design of processes for product development ◦ IT systems for product development ◦ Establishment of management standards ◦ Typical types of organization
Literature	• Bender: Embedded Systems - qualitätsorientierte Entwicklung • Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit • Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen • Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung • Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden • Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung • VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme

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. Kluver Academic Puplisher, Dordrecht, 2001 E. Haibach. Betriebsfestigkeit Verfahren und Daten zur Bauteilberechnung. VDI-Verlag, Düsseldorf, 1989

Course L2012: Industry 4.0 for engineers	
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 min
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	
Literature	

Course L2168: Innovation and Product Management	
Typ	Seminar
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	30 min
Lecturer	Dr. Christoph Fuchs
Language	DE
Cycle	SoSe
Content	
Literature	

Course L1514: Lightweight Construction with Fibre Reinforced Rolymers - Structural Mechanics	
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	30 min
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	WiSe
Content	**Fundamentals of Anisotropic Elasticity** Displacements, strains and stresses; Equilibrium equations; Kinematics; Hooke's generalized law **Behaviour of a single laminate layer** Material law of a single laminate layer; Full anisotropy and coupling effects; Material symmetries; Engineering constants; Plane state of stress; Transformation rules **Fundamentals of Micromechanics of a laminate layer** Representative unit cell; Determination of effective material constants; Effective stiffness properties of a single layer **Classical Laminate Plate Theory** Notations and laminate code; Kinematics and displacement field; Strains and stresses, stress resultants; Constitutive equations and coupling effects; Special laminates and their behavior; Effective laminate properties **Strength of Laminated Plates** Fundamental concept; Phenomenological failure criteria: maximum stresses, maximum strains, Tsai-Hill, Tsai-Wu, Puck, Hashin **Bending of Composite Laminated Plates** Differential Equations; Boundary Conditions; Navier-type solutions; Lévy-type solutions **Stress Concentration Problems** Free-edge effects; Stress concentrations at holes, cracks, delaminations; Aspects of failure analysis **Stability of Thin-Walled Composite Structures** Buckling of anisotropic plates and shells; Influence of loading conditions; Influence of boundary conditions; Exact transcendental solutions and their evaluation; Buckling of stiffened composite plates; Minimum stiffness requirements; Local buckling of stiffener profiles **Written exercise (report required)** Assessment of a thin-walled composite laminated beam taking several different dimensioning criteria into account
Literature	• Schürmann, H., „Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage. • Wiedemann, J., „Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage. • Reddy, J.N., „Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al., current edition. • Jones, R.M., „Mechanics of Composite Materials", Scripta Book Co., Washington, current edition. • Timoshenko, S.P., Gere, J.M., „Theory of elastic stability", McGraw-Hill Book Company, Inc., New York, current edition. • Turvey, G.J., Marshall, I.H., „Buckling and postbuckling of composite plates", Chapman and Hall, London, current edition. • Herakovich, C.T., „Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition. • Mittelstedt, C., Becker, W., „Strukturmechanik ebener Laminate", aktuelle Auflage.

Course L1258: Lightweight Design Practical Course	
Typ	Project-/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/EN
Cycle	SoSe
Content	Development of a sandwich structure made of fibre reinforced plastics • getting familiar with fibre reinforced plastics as well as lightweight design • Design of a sandwich structure made of fibre reinforced plastics using finite element analysis (FEA) • Determination of material properties based on sample tests • manufacturing of the structure in the composite lab • Testing of the developed structure • Concept presentation • Self-organised teamwork
Literature	• Schürmann, H., „Konstruieren mit Faser-Kunststoff-Verbunden“, Springer, Berlin, 2005. • Puck, A., „Festigkeitsanalsyse von Faser-Matrix-Laminaten“, Hanser, München, Wien, 1996. • R&G, „Handbuch Faserverbundwerkstoffe“, Waldenbuch, 2009. • VDI 2014 „Entwicklung von Bauteilen aus Faser-Kunststoff-Verbund“ • Ehrenstein, G. W., „Faserverbundkunststoffe“, Hanser, München, 2006. • Klein, B., „Leichtbau-Konstruktion", Vieweg & Sohn, Braunschweig, 1989. • Wiedemann, J., „Leichtbau Band 1: Elemente“, Springer, Berlin, Heidelberg, 1986. • Wiedemann, J., „Leichtbau Band 2: Konstruktion“, Springer, Berlin, Heidelberg, 1986. • Backmann, B.F., „Composite Structures, Design, Safety and Innovation”, Oxford (UK), Elsevier, 2005. • Krause, D., „Leichtbau”, In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012. • Schulte, K., Fiedler, B., „Structure and Properties of Composite Materials”, Hamburg, TUHH - TuTech Innovation GmbH, 2005.

Course L0950: Mechanisms, Systems and Processes of Materials Testing	
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	Dr. Jan Oke Peters
Language	DE
Cycle	SoSe
Content	Application, analysis and discussion of basic and advanced testing methods to ensure correct selection of applicable testing procedure for investigation of part/materials deficiencies • Stress-strain relationships • Strain gauge application • Visko elastic behavior • Tensile test (strain hardening, necking, strain rate) • Compression test, bending test, torsion test • Crack growth upon static loading (J-Integral) • Crack growth upon cyclic loading (micro- und macro cracks) • Effect of notches • Creep testing (physical creep test, influence of stress and temperature, Larson Miller parameter) • Wear testing • Non destructive testing application for overhaul of jet engines
Literature	• E. Macherauch: Praktikum in Werkstoffkunde, Vieweg • G. E. Dieter: Mechanical Metallurgy, McGraw-Hill • R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg • R. Bürgel: Werkstoffe sícher beurteilen und richtig einsetzen, Vieweg

Course L0724: Microsystems Technology	
Typ	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cycle	WiSe
Content	• Introduction (historical view, scientific and economic relevance, scaling laws) • Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution, next-generation lithography, nano-imprinting, molecular imprinting) • Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVD, LPCVD, PECVD and LECVD; screen printing) • Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA, electrochemical etching, anisotropic etching with KOH/TMAH: theory, corner undercutting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering, plasma etching, RIE, Bosch process, cryo process, XeF2 etching) • Surface Micromachining and alternative Techniques (sacrificial etching, film stress, stiction: theory and counter measures; Origami microstructures, Epi-Poly, porous silicon, SOI, SCREAM process, LIGA, SU8, rapid prototyping) • Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensors: thermo resistor, Pt-100, spreading resistance sensor, pn junction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry, IR sensor: thermopile and bolometer) • Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistivity, pressure sensor: piezoresistive, capacitive and fabrication process; accelerometer: piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process) • Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensors: magneto resistance, AMR and GMR, fluxgate magnetometer) • Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; metal oxide semiconductor gas sensor, organic semiconductor gas sensor, Lambda probe, MOSFET gas sensor, pH-FET, SAW sensor, principle of biosensor, Clark electrode, enzyme electrode, DNA chip) • Micro Actuators, Microfluidics and TAS (drives: thermal, electrostatic, piezo electric and electromagnetic; light modulators, DMD, adaptive optics, microscanner, microvalves: passive and active, micropumps, valveless micropump, electrokinetic micropumps, micromixer, filter, inkjet printhead, microdispenser, microfluidic switching elements, microreactor, lab-on-a-chip, microanalytics) • MEMS in medical Engineering (wireless energy and data transmission, smart pill, implantable drug delivery system, stimulators: microelectrodes, cochlear and retinal implant; implantable pressure sensors, intelligent osteosynthesis, implant for spinal cord regeneration) • Design, Simulation, Test (development and design flows, bottom-up approach, top-down approach, testability, modelling: multiphysics, FEM and equivalent circuit simulation; reliability test, physics-of-failure, Arrhenius equation, bath-tub relationship) • System Integration (monolithic and hybrid integration, assembly and packaging, dicing, electrical contact: wire bonding, TAB and flip chip bonding; packages, chip-on-board, wafer-level-package, 3D integration, wafer bonding: anodic bonding and silicon fusion bonding; micro electroplating, 3D-MID)
Literature	M. Madou: Fundamentals of Microfabrication, CRC Press, 2002 N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009 T. M. Adams, R. A. Layton:Introductory MEMS, Springer, 2010 G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008

Course L0928: Productivity Management	
Typ	Project-/problem-based Learning
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. Hermann Lödding
Language	DE
Cycle	SoSe
Content	• Principles of productivity management • Shop floor management and standardisation • Takt analysis and design of manual operations • Maintenance Principles • Total Productive Maintenance (TPM) • Optimisation of set-up operations • Analysis of interlinked production systems
Literature	Bokranz, R.; Landau, K.:Produktivitätsmanagement von Arbeitssystemen. Schäffer-Poeschel, Stuttgart, 2006. Takeda, H.: Das synchrone Produktionssystem: Just-in-Time für das ganze Unternehmen. 5. Aufl., mi-Wirtschaftsbuch, FinanzBuch Verlag, München, 2006. Nakajima, S.: Management der Produktionseinrichtungen (Total Productive Maintenance). Campus Verlag, New York, 1995. Shingo, S.: A Revolution in Manufacturing: The SMED System. Productivity, Inc., 1985

Course L0931: Productivity Management	
Typ	Recitation Section (small)
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. Hermann Lödding
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0664: Feedback Control in Medical Technology	
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	20 min
Lecturer	Johannes Kreuzer, Christian Neuhaus
Language	DE
Cycle	SoSe
Content	Always viewed from the engineer's point of view, the lecture is structured as follows: • Introduction to the topic • Fundamentals of physiological modelling • Introduction to Breathing and Ventilation • Physiology and Pathology in Cardiology • Introduction to the Regulation of Blood Glucose • kidney function and renal replacement therapy • Representation of the control technology on the concrete ventilator • Excursion to a medical technology company Techniques of modeling, simulation and controller development are discussed. In the models, simple equivalent block diagrams for physiological processes are derived and explained how sensors, controllers and actuators are operated. MATLAB and SIMULINK are used as development tools.
Literature	• Leonhardt, S., & Walter, M. (2016). Medizintechnische Systeme. Berlin, Heidelberg: Springer Vieweg. • Werner, J. (2005). Kooperative und autonome Systeme der Medizintechnik. München: Oldenbourg. • Oczenski, W. (2017). Atmen : Atemhilfen ; Atemphysiologie und Beatmungstechnik: Georg Thieme Verlag KG.

Course L0313: Renewable Energy	
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. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	• introduction • solar energy for heat and power generation • wind power for electricity generation • hydropower for electricity generation • ocean energy for electricity generation • geothermal energy for heat and electricty generation
Literature	• Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage • Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg,2007

Course L1434: Renewable Energy	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	60 Minuten
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	Students work on different tasks in the field of renewable energies. They present their solutions in the exercise lesson and discuss it with other students and the lecturer. Possible tasks in the field of renewable energies are: • Solar thermal heat • Concentrating solare power • Photovoltaic • Windenergie • Hydropower • Heat pump • Deep geothermal energy
Literature	• Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage • Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg,2007

Course L1130: Six Sigma	
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. Claus Emmelmann
Language	DE
Cycle	WiSe
Content	• Introduction and structuring • Basic terms of quality management • Measuring and inspection equipment • Tools of quality management: FMEA, QFD, FTA, etc. • Quality management methodology Six Sigma, DMAIC
Literature	Pfeifer, T.: Qualitätsmanagement : Strategien, Methoden, Techniken, 4. Aufl., München 2008 Pfeifer, T.: Praxishandbuch Qualitätsmanagement, München 1996 Geiger, W., Kotte, W.: Handbuch Qualität : Grundlagen und Elemente des Qualitätsmanagements: Systeme, Perspektiven, 5. Aufl., Wiesbaden 2008

Course L1820: System Simulation	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Stefan Wischhusen
Language	DE
Cycle	WiSe
Content	All participants must bring a notebook, to install and use the software OpenModelica. • Instruction and modelling of physical processes • Modelling and limits of model • Time constant, stiffness, stability, step size • Terms of object orientated programming • Differential equations of simple systems • Introduction into Modelica • Introduction into simulation tool • Example: Heat transfer • Example: System with different subsystems
Literature	[1] Modelica Association: "Modelica Language Specification - Version 3.3", Linköping, Sweden, 2 0 1 2 [2] M. Tiller: “Modelica by Example", http://book.xogeny.com, 2014. [3] M. Otter, H. Elmqvist, et al.: "Objektorientierte Modellierung Physikalischer Systeme", at- Automatisierungstechnik (german), Teil 1 - 17, Oldenbourg Verlag, 1999 - 2000. [4] P. Fritzson: "Principles of Object-Oriented Modeling and Simulation with Modelica 3.3", Wiley-IEEE Press, New York, 2015. [5] P. Fritzson: “Introduction to Modeling and Simulation of Technical and Physical Systems with Modelica”, Wiley, New York, 2011.

Course L1821: System Simulation	
Typ	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Stefan Wischhusen
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1513: Technical Design	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	10-15 Entwurfszeichnungen, Skizzen und ca. 5-10 A4-Dokumentationsseiten (Themen- und Entwurfsbegründung)
Lecturer	Prof. Werner Granzeier
Language	DE
Cycle	SoSe
Content	• Basics with analysis, concept, proposal drawings and sketches • Samples from practice of technical industrial design • Product concept with new ideas and package • ID proposal with structural concept and external product ergonomics • Visualisation and presentation of the overall concept • Realization as individual case studies
Literature	Literatur über technisches Produktdesign Technisches Rendering und Präsentation

Zeichnen und perspektivisches Entwerfen

Literaturhinweise

What is Product Design ?

Laura Slack

RotoVision Schweiz 2006

Product Design Now

Design and Scetches

CollinsDesign and maomao publications Spanien 2006

Ronald B. Kemnitzer, Rendering With Markers - Definitive Techniques

for Designers, Illustrators and Architects,

Watson, Guptil Puplications,a division of Billboard Publications Inc.,

New York 1983

Creative Techniques

DRAWING

Barons Educational Series

ISBN-13: 978-0-7641-6182-7

Joseph Ungar, Rendering In Mixed Media - Techniques for Concept

Presentation for Designers and Illustrators

Watson-Guptil Publication a division of Billboard Publications Inc.,

New York 1985

AIRWORLD

Design und Architektur für die Flugreise

Vitra Design Stiftung   Weil am Rhein 2004

Airline Design

Perter Deslius Jacek Slaski te Neues 2005

Technik und Sicherheit von Passagierflugzeugen

Frank Littek

Motorbuch Verlag 2003

Jetliner Cabins

Jennifer Coutts Clay

Cs books   England 2006

BOEING Widebodies

Michael Haenggi   motorbooks international USA 2003

form - Zeitschrift für Gestaltung, Verlag form GmbH,

Hofgut Ober-Berrbach, 6104 Seeheim-Jugenheim

(erscheint vierteljährlich, Verlag form GmbH)

design report

german magasin,

(erscheint monatlich)

md - möbel interior design, Konradin-Verlag

Robert Kohlhammer GmbH, 7022 Leinfelden-Echterdingen

(erscheint monatlich)

CAR STYLING, Car Styling Publishing Co. 4-8-16-11F,

Kitashinjuku, Shinjuku-ku, Tokio 160, Japan

(erscheint vierteljährlich in japanischer und englischer Sprache, in Hamburg erhältlich bei: Overseas Courier Service Deutschland GmbH,

Auto & Design,

Corso Frabcia 161, 10139 Torino, Italia

	(erscheint vierteljährlich in italienischer und englischer Sprache alle zwei Monate , erhältlich am HBF Hamburg AERO International, Magazin für Zivilluftfahrt (erscheint monatlich) Aircraft interior international Engl. magasin for Aircraft cabin interior (erscheint 2 monatlich) aerotec Technik- und Branchenmagazin für die Luft- und Raumfahrtindustrie

Course L0379: Ceramics Technology	
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	Dr. Rolf Janßen
Language	DE/EN
Cycle	WiSe
Content	Introduction to ceramic processing with emphasis on advanced structural ceramics. The course focus predominatly on powder-based processing, e.g. “powder-metauurgical techniques and sintering (soild state and liquid phase). Also, some aspects of glass and cement science as well as new developments in powderless forming techniques of ceramics and ceramic composites will be addressed Examples will be discussed in order to give engineering students an understanding of technology development and specific applications of ceramic components. **Content:** 1. Introduction Inhalt: 2. Raw materials 3. Powder fabrication 4. Powder processing 5. Shape-forming processes 6. Densification, sintering 7. Glass and Cement technology 8. Ceramic-metal joining techniques
Literature	W.D. Kingery, „Introduction to Ceramics“, John Wiley & Sons, New York, 1975 ASM Engineering Materials Handbook Vol.4 „Ceramics and Glasses“, 1991 D.W. Richerson, „Modern Ceramic Engineering“, Marcel Decker, New York, 1992 Skript zur Vorlesung

Course L0949: Materials Testing	
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	Dr. Jan Oke Peters
Language	DE
Cycle	WiSe
Content	Application and analysis of basic mechanical as well as non-destructive testing of materials • Determination elastic constants • Tensile test • Fatigue test (testing with constant stress, strain, or plastiv strain amplitude, low and high cycle fatigue, mean stress effect) • Crack growth upon static loading (stress intensity factor, fracture toughness) • Creep test • Hardness test • Charpy impact test • Non destructive testing
Literature	E. Macherauch: Praktikum in Werkstoffkunde, Vieweg G. E. Dieter: Mechanical Metallurgy, McGraw-Hill

Course L0176: Reliability in Engineering Dynamics	
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 min.
Lecturer	Prof. Uwe Weltin
Language	EN
Cycle	SoSe
Content	Method for calculation and testing of reliability of dynamic machine systems • Modeling • System identification • Simulation • Processing of measurement data • Damage accumulation • Test planning and execution
Literature	Bertsche, B.: Reliability in Automotive and Mechanical Engineering. Springer, 2008. ISBN: 978-3-540-33969-4 Inman, Daniel J.: Engineering Vibration. Prentice Hall, 3rd Ed., 2007. ISBN-13: 978-0132281737 Dresig, H., Holzweißig, F.: Maschinendynamik, Springer Verlag, 9. Auflage, 2009. ISBN 3540876936. VDA (Hg.): Zuverlässigkeitssicherung bei Automobilherstellern und Lieferanten. Band 3 Teil 2, 3. überarbeitete Auflage, 2004. ISSN 0943-9412

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

Course L0749: Reliability of Aircraft Systems	
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. Frank Thielecke, Dr. Andreas Vahl, Dr. Uwe Wieczorek
Language	DE
Cycle	WiSe
Content	• Functions of reliability and safety (regulations, certification requirements) • Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment) • Reliability analysis of electrical and mechanical systems
Literature	• CS 25.1309 • SAE ARP 4754 • SAE ARP 4761

Module M1156: Systems Engineering

Courses

Title	Typ	Hrs/wk	CP
Systems Engineering (L1547)	Lecture	3	4
Systems Engineering (L1548)	Recitation Section (large)	1	2

Module Responsible	Prof. Ralf God
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Electrical Engineering • Control Systems Previous knowledge in: • Aircraft Cabin Systems
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to: • understand systems engineering process models, methods and tools for the development of complex Systems • describe innovation processes and the need for technology Management • explain the aircraft development process and the process of type certification for aircraft • explain the system development process, including requirements for systems reliability • identify environmental conditions and test procedures for airborne Equipment • value the methodology of requirements-based engineering (RBE) and model-based requirements engineering (MBRE)
Skills	Students are able to: • plan the process for the development of complex Systems • organize the development phases and development Tasks • assign required business activities and technical Tasks • apply systems engineering methods and tools
Personal Competence	
Social Competence	Students are able to: • understand their responsibilities within a development team and integrate themselves with their role in the overall process
Autonomy	Students are able to: • interact and communicate in a development team which has distributed tasks
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 Minutes
Assignment for the Following Curricula	Aircraft Systems Engineering: Core Qualification: Compulsory International Management and Engineering: Specialisation II. Aviation Systems: Elective Compulsory International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory

Course L1547: Systems Engineering	
Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Ralf God
Language	DE
Cycle	SoSe
Content	The objective of the lecture with the corresponding exercise is to accomplish the prerequisites for the development and integration of complex systems using the example of commercial aircraft and cabin systems. Competences in the systems engineering process, tools and methods is to be achieved. Regulations, guidelines and certification issues will be known. Key aspects of the course are processes for innovation and technology management, system design, system integration and certification as well as tools and methods for systems engineering: • Innovation processes • IP-protection • Technology management • Systems engineering • Aircraft program • Certification issues • Systems development • Safety objectives and fault tolerance • Environmental and operating conditions • Tools for systems engineering • Requirements-based engineering (RBE) • Model-based requirements engineering (MBRE)
Literature	- Skript zur Vorlesung - diverse Normen und Richtlinien (EASA, FAA, RTCA, SAE) - Hauschildt, J., Salomo, S.: Innovationsmanagement. Vahlen, 5. Auflage, 2010 - NASA Systems Engineering Handbook, National Aeronautics and Space Administration, 2007 - Hinsch, M.: Industrielles Luftfahrtmanagement: Technik und Organisation luftfahrttechnischer Betriebe. Springer, 2010 - De Florio, P.: Airworthiness: An Introduction to Aircraft Certification. Elsevier Ltd., 2010 - Pohl, K.: Requirements Engineering. Grundlagen, Prinzipien, Techniken. 2. korrigierte Auflage, dpunkt.Verlag, 2008

Course L1548: Systems Engineering	
Typ	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Ralf God
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1161: Turbomachinery

Courses			
Title	**Typ**	**Hrs/wk**	**CP**
Turbomachines (L1562)	Lecture	3	4
Turbomachines (L1563)	Recitation Section (large)	1	2

Module Responsible	Prof. Franz Joos
Admission Requirements	None
Recommended Previous Knowledge	Technical Thermodynamics I, II, Fluid Dynamics, Heat Transfer
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students can • distinguish the physical phenomena of conversion of energy, • understand the different mathematic modelling of turbomachinery, • calculate and evaluate turbomachinery.
Skills	The students are able to - understand the physics of Turbomachinery, - solve excersises self-consistent.
Personal Competence	
Social Competence	The students are able to • discuss in small groups and develop an approach.
Autonomy	The students are able to • develop a complex problem self-consistent, • analyse the results in a critical way, • have an qualified exchange with other students.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Energy Systems: Specialisation Marine Engineering: Elective Compulsory Energy Systems: Specialisation Energy Systems: 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory

Course L1562: Turbomachines

Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Markus Schatz, Prof. Dr. Karsten Meier
Language	DE
Cycle	SoSe
Content	Topics to be covered will include: • Application cases of turbomachinery • Fundamentals of thermodynamics and fluid mechanics • Design fundamentals of turbomachinery • Introduction to the theory of turbine stage • Design and operation of the turbocompressor • Design and operation of the steam turbine • Design and operation of the gas turbine • Physical limits of the turbomachines
Literature	• Traupel: Thermische Turbomaschinen, Springer. Berlin, Heidelberg, New York • Bräunling: Flugzeuggasturbinen, Springer., Berlin, Heidelberg, New York • Seume: Stationäre Gasturbinen, Springer., Berlin, Heidelberg, New York • Menny: Strömungsmaschinen, Teubner., Stuttgart

Course L1563: Turbomachines	
Typ	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Markus Schatz, Prof. Dr. Karsten Meier
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1170: Phenomena and Methods in Materials Science

Courses

Title	Typ	Hrs/wk	CP
Experimental Methods for the Characterization of Materials (L1580)	Lecture	2	3
Phase equilibria and transformations (L1579)	Lecture	2	3

Module Responsible	Prof. Patrick Huber
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge in Materials Science, e.g. Werkstoffwissenschaft I/II
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	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.
Skills	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.
Personal Competence	
Social Competence	The students are able to present solutions to specialists and to develop ideas further.
Autonomy	The students are able to ... • assess their own strengths and weaknesses. • gather new necessary expertise by their own.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	International Management and Engineering: Specialisation II. Product Development and Production: 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 Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Materials Science: Elective Compulsory

Course L1580: Experimental Methods for the Characterization of Materials

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Patrick Huber
Language	DE
Cycle	SoSe
Content	• Structural characterization by photons, neutrons and electrons (in particular X-ray and neutron scattering, electron microscopy, tomography) • Mechanical and thermodynamical characterization methods (indenter measurements, mechanical compression and tension tests, specific heat measurements) • Characterization of optical, electrical and magnetic properties (spectroscopy, electrical conductivity and magnetometry)
Literature	William D. Callister und David G. Rethwisch, Materialwissenschaften und Werkstofftechnik, Wiley&Sons, Asia (2011). William D. Callister, Materials Science and Technology, Wiley& Sons, Inc. (2007).

Course L1579: Phase equilibria and transformations	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Jörg Weißmüller
Language	DE
Cycle	SoSe
Content	Fundamentals of statistical physics, formal structure of phenomenological thermodynamics, simple atomistic models and free-energy functions of solid solutions and compounds. Corrections due to nonlocal interaction (elasticity, gradient terms). Phase equilibria and alloy phase diagrams as consequence thereof. Simple atomistic considerations for interaction energies in metallic solid solutions. Diffusion in real systems. Kinetics of phase transformations for real-life boundary conditions. Partitioning, stability and morphology at solidification fronts. Order of phase transformations; glass transition. Phase transitions in nano- and microscale systems.
Literature	Wird im Rahmen der Lehrveranstaltung bekannt gegeben.

Module M1209: Selected Topics of Product Development, Materials Science and Production (Alternative B: 6 LP)

Courses

Title	Typ	Hrs/wk	CP
Applied Automation (L1592)	Project-/problem-based Learning	3	3
Ergonomics (L0653)	Lecture	2	3
Elements of Integrated Production Systems (L0927)	Project-/problem-based Learning	2	3
Emotional Design / User Centered Product Development (L1703)	Seminar	2	2
Development Management for Mechatronics (L1512)	Lecture	2	3
Fatigue & Damage Tolerance (L0310)	Lecture	2	3
Industry 4.0 for engineers (L2012)	Lecture	2	3
Innovation and Product Management (L2168)	Seminar	2	3
Lightweight Construction with Fibre Reinforced Rolymers - Structural Mechanics (L1514)	Lecture	2	3
Lightweight Design Practical Course (L1258)	Project-/problem-based Learning	3	3
Mechanisms, Systems and Processes of Materials Testing (L0950)	Lecture	2	2
Microsystems Technology (L0724)	Lecture	2	4
Productivity Management (L0928)	Project-/problem-based Learning	2	2
Productivity Management (L0931)	Recitation Section (small)	1	1
Feedback Control in Medical Technology (L0664)	Lecture	2	3
Renewable Energy (L0313)	Lecture	2	2
Renewable Energy (L1434)	Recitation Section (small)	1	1
Six Sigma (L1130)	Lecture	2	3
System Simulation (L1820)	Lecture	2	2
System Simulation (L1821)	Recitation Section (large)	1	2
Technical Design (L1513)	Lecture	2	3
Ceramics Technology (L0379)	Lecture	2	3
Materials Testing (L0949)	Lecture	2	2
Reliability in Engineering Dynamics (L0176)	Lecture	2	2
Reliability in Engineering Dynamics (L1303)	Recitation Section (small)	1	2
Reliability of Aircraft Systems (L0749)	Lecture	2	3

Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous Knowledge	None
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students are able to express their extended knowledge and discuss the connection of different special fields or application areas of product development, materials and production • Students are qualified to connect different special fields with each other
Skills	• Students can apply specialized solution strategies and new scientific methods in selected areas • Students are able to transfer learned skills to new and unknown problems and can develop own solution approaches
Personal Competence	
Social Competence	-
Autonomy	• Students are able to develop their knowledge and skills by autonomous election of courses.
Workload in Hours	Depends on choice of courses
Credit points	6
Assignment for the Following Curricula	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

Course L1592: Applied Automation	
Typ	Project-/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 Minuten
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	-Project Based Learning -Robot Operating System -Robot structure and description -Motion description -Calibration -Accuracy
Literature	John J. Craig Introduction to Robotics – Mechanics and Control ISBN: 0131236296 Pearson Education, Inc., 2005 Stefan Hesse Grundlagen der Handhabungstechnik ISBN: 3446418725 München Hanser, 2010 K. Thulasiraman and M. N. S. Swamy Graphs: Theory and Algorithms ISBN: 9781118033104 John Wüey & Sons, Inc., 1992

Course L0653: Ergonomics	
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	30 Minuten
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	

Course L0927: Elements of Integrated Production Systems	
Typ	Project-/problem-based Learning
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. Hermann Lödding
Language	DE
Cycle	SoSe
Content	not available
Literature	Harris, R.; Harris, C.; Wilson, E.: Making Materials Flow, Lean Enterprise Institute, Cambridge, 2003. Ohno, T.: Das Toyota-Produktionssystem, Campus-Verlag, Frankfurt et al, 1993. Rother, M.: Die Kata des Weltmarktführers. Toyotas Erfolgsmethoden, Campus-Verlag, Frankfurt et al, 2009. Rother, M.; Shook, J.: Sehen lernen: Mit Wertstromdesign die Wertschöpfung erhöhen und Verschwendung beseitigen, Lean Management Institut, Aachen, 2006. Rother, M.; Harris, R.: Creating Continuous Flow, Lean Enterprise Institute, Brookline, 2001. Shingo, S.: A Revolution in Manufacturing. The SMED System, Productivity Press, 2006. Womack, J. P. et al: Die zweite Revolution in der Autoindustrie, Frankfurt/New York, Campus Verlag, 1992.

Course L1703: Emotional Design / User Centered Product Development	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	Teamarbeit und abschließender Vortrag
Lecturer	Jörg Heuser
Language	DE
Cycle	SoSe
Content	Lecture • Objective and subjective perception for the evaluation of product characteristics • Effects of material, color, shape and structure to the acceptance of a product • Aesthetic function of a product • Case studies, lack of acceptance of a product and possible reason Seminar • Identification of non-technical product functions • Identification of subjective influences for the product development Project Work • Topics will be developed in cooperation with the students. Project works will be presented in teams, presented and evaluated Exemplary Project: Holistic product evaluation, product optimization
Literature	Wird in der Veranstaltung angegeben

Course L1512: Development Management for Mechatronics	
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	30 Minuten
Lecturer	Dr. Daniel Steffen
Language	DE
Cycle	SoSe
Content	• Processes and methods of product development - from idea to market launch ∘ identification of market and technology potentials ∘ development of a common product architecture ∘ Synchronized product development across all engineering disciplines ∘ product validation incl. customer view • Steering and optimization of product development ∘ Design of processes for product development ∘ IT systems for product development ∘ Establishment of management standards ∘ Typical types of organization
Literature	• Bender: Embedded Systems - qualitätsorientierte Entwicklung • Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit • Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen • Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung • Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden • Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung • VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme

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. Kluver Academic Puplisher, Dordrecht, 2001 E. Haibach. Betriebsfestigkeit Verfahren und Daten zur Bauteilberechnung. VDI-Verlag, Düsseldorf, 1989

Course L2012: Industry 4.0 for engineers	
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 min
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	
Literature	

Course L2168: Innovation and Product Management	
Typ	Seminar
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	30 min
Lecturer	Dr. Christoph Fuchs
Language	DE
Cycle	SoSe
Content	
Literature	

Course L1514: Lightweight Construction with Fibre Reinforced Rolymers - Structural Mechanics	
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	30 min
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	WiSe
Content	**Fundamentals of Anisotropic Elasticity** Displacements, strains and stresses; Equilibrium equations; Kinematics; Hooke's generalized law **Behaviour of a single laminate layer** Material law of a single laminate layer; Full anisotropy and coupling effects; Material symmetries; Engineering constants; Plane state of stress; Transformation rules **Fundamentals of Micromechanics of a laminate layer** Representative unit cell; Determination of effective material constants; Effective stiffness properties of a single layer **Classical Laminate Plate Theory** Notations and laminate code; Kinematics and displacement field; Strains and stresses, stress resultants; Constitutive equations and coupling effects; Special laminates and their behavior; Effective laminate properties **Strength of Laminated Plates** Fundamental concept; Phenomenological failure criteria: maximum stresses, maximum strains, Tsai-Hill, Tsai-Wu, Puck, Hashin **Bending of Composite Laminated Plates** Differential Equations; Boundary Conditions; Navier-type solutions; Lévy-type solutions **Stress Concentration Problems** Free-edge effects; Stress concentrations at holes, cracks, delaminations; Aspects of failure analysis **Stability of Thin-Walled Composite Structures** Buckling of anisotropic plates and shells; Influence of loading conditions; Influence of boundary conditions; Exact transcendental solutions and their evaluation; Buckling of stiffened composite plates; Minimum stiffness requirements; Local buckling of stiffener profiles **Written exercise (report required)** Assessment of a thin-walled composite laminated beam taking several different dimensioning criteria into account
Literature	• Schürmann, H., „Konstruieren mit Faser-Kunststoff-Verbunden“, Springer, Berlin, aktuelle Auflage. • Wiedemann, J., „Leichtbau Band 1: Elemente“, Springer, Berlin, Heidelberg, , aktuelle Auflage. • Reddy, J.N., „Mechanics of Composite Laminated Plates and Shells”, CRC Publishing, Boca Raton et al., current edition. • Jones, R.M., „Mechanics of Composite Materials“, Scripta Book Co., Washington, current edition. • Timoshenko, S.P., Gere, J.M., „Theory of elastic stability“, McGraw-Hill Book Company, Inc., New York, current edition. • Turvey, G.J., Marshall, I.H., „Buckling and postbuckling of composite plates“, Chapman and Hall, London, current edition. • Herakovich, C.T., „Mechanics of fibrous composites“, John Wiley and Sons, Inc., New York, current edition. • Mittelstedt, C., Becker, W., „Strukturmechanik ebener Laminate”, aktuelle Auflage.

Course L1258: Lightweight Design Practical Course	
Typ	Project-/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/EN
Cycle	SoSe
Content	Development of a sandwich structure made of fibre reinforced plastics • getting familiar with fibre reinforced plastics as well as lightweight design • Design of a sandwich structure made of fibre reinforced plastics using finite element analysis (FEA) • Determination of material properties based on sample tests • manufacturing of the structure in the composite lab • Testing of the developed structure • Concept presentation • Self-organised teamwork
Literature	• Schürmann, H., „Konstruieren mit Faser-Kunststoff-Verbunden“, Springer, Berlin, 2005. • Puck, A., „Festigkeitsanalsyse von Faser-Matrix-Laminaten“, Hanser, München, Wien, 1996. • R&G, „Handbuch Faserverbundwerkstoffe“, Waldenbuch, 2009. • VDI 2014 „Entwicklung von Bauteilen aus Faser-Kunststoff-Verbund“ • Ehrenstein, G. W., „Faserverbundkunststoffe“, Hanser, München, 2006. • Klein, B., „Leichtbau-Konstruktion", Vieweg & Sohn, Braunschweig, 1989. • Wiedemann, J., „Leichtbau Band 1: Elemente“, Springer, Berlin, Heidelberg, 1986. • Wiedemann, J., „Leichtbau Band 2: Konstruktion“, Springer, Berlin, Heidelberg, 1986. • Backmann, B.F., „Composite Structures, Design, Safety and Innovation”, Oxford (UK), Elsevier, 2005. • Krause, D., „Leichtbau”, In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012. • Schulte, K., Fiedler, B., „Structure and Properties of Composite Materials”, Hamburg, TUHH - TuTech Innovation GmbH, 2005.

Course L0950: Mechanisms, Systems and Processes of Materials Testing	
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	Dr. Jan Oke Peters
Language	DE
Cycle	SoSe
Content	Application, analysis and discussion of basic and advanced testing methods to ensure correct selection of applicable testing procedure for investigation of part/materials deficiencies • Stress-strain relationships • Strain gauge application • Visko elastic behavior • Tensile test (strain hardening, necking, strain rate) • Compression test, bending test, torsion test • Crack growth upon static loading (J-Integral) • Crack growth upon cyclic loading (micro- und macro cracks) • Effect of notches • Creep testing (physical creep test, influence of stress and temperature, Larson Miller parameter) • Wear testing • Non destructive testing application for overhaul of jet engines
Literature	• E. Macherauch: Praktikum in Werkstoffkunde, Vieweg • G. E. Dieter: Mechanical Metallurgy, McGraw-Hill • R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg • R. Bürgel: Werkstoffe sícher beurteilen und richtig einsetzen, Vieweg

Course L0724: Microsystems Technology	
Typ	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cycle	WiSe
Content	• Introduction (historical view, scientific and economic relevance, scaling laws) • Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution, next-generation lithography, nano-imprinting, molecular imprinting) • Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVD, LPCVD, PECVD and LECVD; screen printing) • Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA, electrochemical etching, anisotropic etching with KOH/TMAH: theory, corner undercutting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering, plasma etching, RIE, Bosch process, cryo process, XeF2 etching) • Surface Micromachining and alternative Techniques (sacrificial etching, film stress, stiction: theory and counter measures; Origami microstructures, Epi-Poly, porous silicon, SOI, SCREAM process, LIGA, SU8, rapid prototyping) • Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensors: thermo resistor, Pt-100, spreading resistance sensor, pn junction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry, IR sensor: thermopile and bolometer) • Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistivity, pressure sensor: piezoresistive, capacitive and fabrication process; accelerometer: piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process) • Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensors: magneto resistance, AMR and GMR, fluxgate magnetometer) • Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; metal oxide semiconductor gas sensor, organic semiconductor gas sensor, Lambda probe, MOSFET gas sensor, pH-FET, SAW sensor, principle of biosensor, Clark electrode, enzyme electrode, DNA chip) • Micro Actuators, Microfluidics and TAS (drives: thermal, electrostatic, piezo electric and electromagnetic; light modulators, DMD, adaptive optics, microscanner, microvalves: passive and active, micropumps, valveless micropump, electrokinetic micropumps, micromixer, filter, inkjet printhead, microdispenser, microfluidic switching elements, microreactor, lab-on-a-chip, microanalytics) • MEMS in medical Engineering (wireless energy and data transmission, smart pill, implantable drug delivery system, stimulators: microelectrodes, cochlear and retinal implant; implantable pressure sensors, intelligent osteosynthesis, implant for spinal cord regeneration) • Design, Simulation, Test (development and design flows, bottom-up approach, top-down approach, testability, modelling: multiphysics, FEM and equivalent circuit simulation; reliability test, physics-of-failure, Arrhenius equation, bath-tub relationship) • System Integration (monolithic and hybrid integration, assembly and packaging, dicing, electrical contact: wire bonding, TAB and flip chip bonding; packages, chip-on-board, wafer-level-package, 3D integration, wafer bonding: anodic bonding and silicon fusion bonding; micro electroplating, 3D-MID)
Literature	M. Madou: Fundamentals of Microfabrication, CRC Press, 2002 N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009 T. M. Adams, R. A. Layton:Introductory MEMS, Springer, 2010 G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008

Course L0928: Productivity Management	
Typ	Project-/problem-based Learning
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. Hermann Lödding
Language	DE
Cycle	SoSe
Content	• Principles of productivity management • Shop floor management and standardisation • Takt analysis and design of manual operations • Maintenance Principles • Total Productive Maintenance (TPM) • Optimisation of set-up operations • Analysis of interlinked production systems
Literature	Bokranz, R.; Landau, K.:Produktivitätsmanagement von Arbeitssystemen. Schäffer-Poeschel, Stuttgart, 2006. Takeda, H.: Das synchrone Produktionssystem: Just-in-Time für das ganze Unternehmen. 5. Aufl., mi-Wirtschaftsbuch, FinanzBuch Verlag, München, 2006. Nakajima, S.: Management der Produktionseinrichtungen (Total Productive Maintenance). Campus Verlag, New York, 1995. Shingo, S.: A Revolution in Manufacturing: The SMED System. Productivity, Inc., 1985

Course L0931: Productivity Management	
Typ	Recitation Section (small)
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. Hermann Lödding
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0664: Feedback Control in Medical Technology	
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	20 min
Lecturer	Johannes Kreuzer, Christian Neuhaus
Language	DE
Cycle	SoSe
Content	Always viewed from the engineer's point of view, the lecture is structured as follows: • Introduction to the topic • Fundamentals of physiological modelling • Introduction to Breathing and Ventilation • Physiology and Pathology in Cardiology • Introduction to the Regulation of Blood Glucose • kidney function and renal replacement therapy • Representation of the control technology on the concrete ventilator • Excursion to a medical technology company Techniques of modeling, simulation and controller development are discussed. In the models, simple equivalent block diagrams for physiological processes are derived and explained how sensors, controllers and actuators are operated. MATLAB and SIMULINK are used as development tools.
Literature	• Leonhardt, S., & Walter, M. (2016). Medizintechnische Systeme. Berlin, Heidelberg: Springer Vieweg. • Werner, J. (2005). Kooperative und autonome Systeme der Medizintechnik. München: Oldenbourg. • Oczenski, W. (2017). Atmen : Atemhilfen ; Atemphysiologie und Beatmungstechnik: Georg Thieme Verlag KG.

Course L0313: Renewable Energy	
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. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	• introduction • solar energy for heat and power generation • wind power for electricity generation • hydropower for electricity generation • ocean energy for electricity generation • geothermal energy for heat and electricty generation
Literature	• Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage • Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg,2007

Course L1434: Renewable Energy	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	60 Minuten
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	Students work on different tasks in the field of renewable energies. They present their solutions in the exercise lesson and discuss it with other students and the lecturer. Possible tasks in the field of renewable energies are: • Solar thermal heat • Concentrating solare power • Photovoltaic • Windenergie • Hydropower • Heat pump • Deep geothermal energy
Literature	• Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage • Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg,2007

Course L1130: Six Sigma	
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. Claus Emmelmann
Language	DE
Cycle	WiSe
Content	• Introduction and structuring • Basic terms of quality management • Measuring and inspection equipment • Tools of quality management: FMEA, QFD, FTA, etc. • Quality management methodology Six Sigma, DMAIC
Literature	Pfeifer, T.: Qualitätsmanagement : Strategien, Methoden, Techniken, 4. Aufl., München 2008 Pfeifer, T.: Praxishandbuch Qualitätsmanagement, München 1996 Geiger, W., Kotte, W.: Handbuch Qualität : Grundlagen und Elemente des Qualitätsmanagements: Systeme, Perspektiven, 5. Aufl., Wiesbaden 2008

Course L1820: System Simulation	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Stefan Wischhusen
Language	DE
Cycle	WiSe
Content	All participants must bring a notebook, to install and use the software OpenModelica. • Instruction and modelling of physical processes • Modelling and limits of model • Time constant, stiffness, stability, step size • Terms of object orientated programming • Differential equations of simple systems • Introduction into Modelica • Introduction into simulation tool • Example: Heat transfer • Example: System with different subsystems
Literature	[1] Modelica Association: "Modelica Language Specification - Version 3.3", Linköping, Sweden, 2 0 1 2 [2] M. Tiller: "Modelica by Example", http://book.xogeny.com, 2014. [3] M. Otter, H. Elmqvist, et al.: "Objektorientierte Modellierung Physikalischer Systeme", at- Automatisierungstechnik (german), Teil 1 - 17, Oldenbourg Verlag, 1999 - 2000. [4] P. Fritzson: "Principles of Object-Oriented Modeling and Simulation with Modelica 3.3", Wiley-IEEE Press, New York, 2015. [5] P. Fritzson: "Introduction to Modeling and Simulation of Technical and Physical Systems with Modelica", Wiley, New York, 2011.

Course L1821: System Simulation	
Typ	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Stefan Wischhusen
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1513: Technical Design	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	10-15 Entwurfszeichnungen, Skizzen und ca. 5-10 A4-Dokumentationsseiten (Themen- und Entwurfsbegründung)
Lecturer	Prof. Werner Granzeier
Language	DE
Cycle	SoSe
Content	• Basics with analysis, concept, proposal drawings and sketches • Samples from practice of technical industrial design • Product concept with new ideas and package • ID proposal with structural concept and external product ergonomics • Visualisation and presentation of the overall concept • Realization as individual case studies
Literature	Literatur über technisches Produktdesign Technisches Rendering und Präsentation

Zeichnen und perspektivisches Entwerfen

Literaturhinweise

What is Product Design ?

Laura Slack

RotoVision Schweiz 2006

Product Design Now

Design and Scetches

CollinsDesign and maomao publications Spanien 2006

Ronald B. Kemnitzer, Rendering With Markers - Definitive Techniques

for Designers, Illustrators and Architects,

Watson, Guptil Puplications,a division of Billboard Publications Inc.,

New York 1983

Creative Techniques

DRAWING

Barons Educational Series

ISBN-13: 978-0-7641-6182-7

Joseph Ungar, Rendering In Mixed Media - Techniques for Concept

Presentation for Designers and Illustrators

Watson-Guptil Publication a division of Billboard Publications Inc.,

New York 1985

AIRWORLD

Design und Architektur für die Flugreise

Vitra Design Stiftung   Weil am Rhein 2004

Airline Design

Perter Deslius Jacek Slaski te Neues 2005

Technik und Sicherheit von Passagierflugzeugen

Frank Littek

Motorbuch Verlag 2003

Jetliner Cabins

Jennifer Coutts Clay

Cs books   England 2006

BOEING Widebodies

Michael Haenggi   motorbooks international USA 2003

form - Zeitschrift für Gestaltung, Verlag form GmbH,

Hofgut Ober-Berrbach, 6104 Seeheim-Jugenheim

(erscheint vierteljährlich, Verlag form GmbH)

design report

german magasin,

(erscheint monatlich)

md - möbel interior design, Konradin-Verlag

Robert Kohlhammer GmbH, 7022 Leinfelden-Echterdingen

(erscheint monatlich)

CAR STYLING, Car Styling Publishing Co. 4-8-16-11F,

Kitashinjuku, Shinjuku-ku, Tokio 160, Japan

(erscheint vierteljährlich in japanischer und englischer Sprache, in Hamburg erhältlich bei: Overseas Courier Service Deutschland GmbH,

Auto & Design,

Corso Frabcia 161, 10139 Torino, Italia

	(erscheint vierteljährlich in italienischer und englischer Sprache alle zwei Monate , erhältlich am HBF Hamburg AERO International, Magazin für Zivilluftfahrt (erscheint monatlich) Aircraft interior international Engl. magasin for Aircraft cabin interior (erscheint 2 monatlich) aerotec Technik- und Branchenmagazin für die Luft- und Raumfahrtindustrie

Course L0379: Ceramics Technology	
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	Dr. Rolf Janßen
Language	DE/EN
Cycle	WiSe
Content	Introduction to ceramic processing with emphasis on advanced structural ceramics. The course focus predominatly on powder-based processing, e.g. “powder-metauurgical techniques and sintering (soild state and liquid phase). Also, some aspects of glass and cement science as well as new developments in powderless forming techniques of ceramics and ceramic composites will be addressed Examples will be discussed in order to give engineering students an understanding of technology development and specific applications of ceramic components. **Content:** 1. Introduction Inhalt: 2. Raw materials 3. Powder fabrication 4. Powder processing 5. Shape-forming processes 6. Densification, sintering 7. Glass and Cement technology 8. Ceramic-metal joining techniques
Literature	W.D. Kingery, „Introduction to Ceramics“, John Wiley & Sons, New York, 1975 ASM Engineering Materials Handbook Vol.4 „Ceramics and Glasses“, 1991 D.W. Richerson, „Modern Ceramic Engineering“, Marcel Decker, New York, 1992 Skript zur Vorlesung

Course L0949: Materials Testing	
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	Dr. Jan Oke Peters
Language	DE
Cycle	WiSe
Content	Application and analysis of basic mechanical as well as non-destructive testing of materials • Determination elastic constants • Tensile test • Fatigue test (testing with constant stress, strain, or plastiv strain amplitude, low and high cycle fatigue, mean stress effect) • Crack growth upon static loading (stress intensity factor, fracture toughness) • Creep test • Hardness test • Charpy impact test • Non destructive testing
Literature	E. Macherauch: Praktikum in Werkstoffkunde, Vieweg G. E. Dieter: Mechanical Metallurgy, McGraw-Hill

Course L0176: Reliability in Engineering Dynamics	
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 min.
Lecturer	Prof. Uwe Weltin
Language	EN
Cycle	SoSe
Content	Method for calculation and testing of reliability of dynamic machine systems • Modeling • System identification • Simulation • Processing of measurement data • Damage accumulation • Test planning and execution
Literature	Bertsche, B.: Reliability in Automotive and Mechanical Engineering. Springer, 2008. ISBN: 978-3-540-33969-4 Inman, Daniel J.: Engineering Vibration. Prentice Hall, 3rd Ed., 2007. ISBN-13: 978-0132281737 Dresig, H., Holzweißig, F.: Maschinendynamik, Springer Verlag, 9. Auflage, 2009. ISBN 3540876936. VDA (Hg.): Zuverlässigkeitssicherung bei Automobilherstellern und Lieferanten. Band 3 Teil 2, 3. überarbeitete Auflage, 2004. ISSN 0943-9412

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

Course L0749: Reliability of Aircraft Systems	
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. Frank Thielecke, Dr. Andreas Vahl, Dr. Uwe Wieczorek
Language	DE
Cycle	WiSe
Content	• Functions of reliability and safety (regulations, certification requirements) • Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment) • Reliability analysis of electrical and mechanical systems
Literature	• CS 25.1309 • SAE ARP 4754 • SAE ARP 4761

Module M1226: Mechanical Properties

Courses

Title	Typ	Hrs/wk	CP
Mechanical Behaviour of Brittle Materials (L1661)	Lecture	2	3
Dislocation Theory of Plasticity (L1662)	Lecture	2	3

Module Responsible	Dr. Erica Lilleodden
Admission Requirements	None
Recommended Previous Knowledge	Basics in Materials Science I/II
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can explain basic principles of crystallography, statics (free body diagrams, tractions) and thermodynamics (energy minimization, energy barriers, entropy)
Skills	Students are capable of using standardized calculation methods: tensor calculations, derivatives, integrals, tensor transformations
Personal Competence	
Social Competence	Students can provide appropriate feedback and handle feedback on their own performance constructively.
Autonomy	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
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Materials Science: Core Qualification: Compulsory Mechanical Engineering and Management: Specialisation Materials: 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: Compulsory Theoretical Mechanical Engineering: Specialisation Materials Science: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

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

Course L1662: Dislocation Theory of Plasticity	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Erica Lilleodden
Language	DE/EN
Cycle	SoSe
Content	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. 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.
Literature	Vorlesungsskript Aktuelle Publikationen Bücher: Introduction to Dislocations, by D. Hull and D.J. Bacon Theory of Dislocations, by J.P. Hirth and J. Lothe Physical Metallurgy, by Peter Hassen

Module M0840: Optimal and Robust Control

Courses			
Title	**Typ**	**Hrs/wk**	**CP**
Optimal and Robust Control (L0658)	Lecture	2	3
Optimal and Robust Control (L0659)	Recitation Section (small)	2	3

Module Responsible	Prof. Herbert Werner
Admission Requirements	None
Recommended Previous Knowledge	• Classical control (frequency response, root locus) • State space methods • Linear algebra, singular value decomposition
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students can explain the significance of the matrix Riccati equation for the solution of LQ problems. • They can explain the duality between optimal state feedback and optimal state estimation. • They can explain how the H2 and H-infinity norms are used to represent stability and performance constraints. • They can explain how an LQG design problem can be formulated as special case of an H2 design problem. • They can explain how model uncertainty can be represented in a way that lends itself to robust controller design • They can explain how - based on the small gain theorem - a robust controller can guarantee stability and performance for an uncertain plant. • They understand how analysis and synthesis conditions on feedback loops can be represented as linear matrix inequalities.
Skills	• Students are capable of designing and tuning LQG controllers for multivariable plant models. • They are capable of representing a H2 or H-infinity design problem in the form of a generalized plant, and of using standard software tools for solving it. • They are capable of translating time and frequency domain specifications for control loops into constraints on closed-loop sensitivity functions, and of carrying out a mixed-sensitivity design. • They are capable of constructing an LFT uncertainty model for an uncertain system, and of designing a mixed-objective robust controller. • They are capable of formulating analysis and synthesis conditions as linear matrix inequalities (LMI), and of using standard LMI-solvers for solving them. • They can carry out all of the above using standard software tools (Matlab robust control toolbox).
Personal Competence	
Social Competence	Students can work in small groups on specific problems to arrive at joint solutions.
Autonomy	Students are able to find required information in sources provided (lecture notes, literature, software documentation) and use it to solve given problems.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Oral exam
Examination duration and scale	30 min
Assignment for the Following Curricula	Computer Science: Specialisation Intelligence Engineering: Elective Compulsory Electrical Engineering: Specialisation Control and Power Systems Engineering: Elective Compulsory Energy Systems: Core Qualification: Elective Compulsory Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory Mechatronics: Specialisation System Design: 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 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Core Qualification: Elective Compulsory

Course L0658: Optimal and Robust Control	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	EN
Cycle	SoSe
Content	• Optimal regulator problem with finite time horizon, Riccati differential equation • Time-varying and steady state solutions, algebraic Riccati equation, Hamiltonian system • Kalman's identity, phase margin of LQR controllers, spectral factorization • Optimal state estimation, Kalman filter, LQG control • Generalized plant, review of LQG control • Signal and system norms, computing H2 and H∞ norms • Singular value plots, input and output directions • Mixed sensitivity design, H∞ loop shaping, choice of weighting filters • Case study: design example flight control • Linear matrix inequalities, design specifications as LMI constraints (H2, H∞ and pole region) • Controller synthesis by solving LMI problems, multi-objective design • Robust control of uncertain systems, small gain theorem, representation of parameter uncertainty
Literature	• Werner, H., Lecture Notes: "Optimale und Robuste Regelung" • Boyd, S., L. El Ghaoui, E. Feron and V. Balakrishnan "Linear Matrix Inequalities in Systems and Control", SIAM, Philadelphia, PA, 1994 • Skogestad, S. and I. Postlewhaite "Multivariable Feedback Control", John Wiley, Chichester, England, 1996 • Strang, G. "Linear Algebra and its Applications", Harcourt Brace Jovanovic, Orlando, FA, 1988 • Zhou, K. and J. Doyle "Essentials of Robust Control", Prentice Hall International, Upper Saddle River, NJ, 1998

Course L0659: Optimal and Robust Control	
Typ	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1344: Processing of fibre-polymer-composites

Courses			
Title	**Typ**	**Hrs/wk**	**CP**
Processing of fibre-polymer-composites (L1895)	Lecture	2	3
From Molecule to Composites Part (L1516)	Project-/problem-based Learning	2	3

Module Responsible	Prof. Bodo Fiedler
Admission Requirements	None
Recommended Previous Knowledge	Knowledge in the basics of chemistry / physics / materials science
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to give a summary of the technical details of the manufacturing processes composites and illustrate respective relationships. They are capable of describing and communicating relevant problems and questions using appropriate technical language. They can explain the typical process of solving practical problems and present related results.
Skills	Students can use the knowledge of fiber-reinforced composites (FRP) and its constituents (fiber / matrix) and define the necessary testing and analysis. They can explain the complex structure-property relationship and the interactions of chemical structure of the polymers, their processing with the different fiber types, including to explain neighboring contexts (e.g. sustainability, environmental protection).
Personal Competence	
Social Competence	Students are able to cooperate in small, mixed-subject groups in order to independently derive solutions to given problems in the context of civil engineering. They are able to effectively present and explain their results alone or in groups in front of a qualified audience. Students have the ability to develop alternative approaches to an engineering problem independently or in groups and discuss advantages as well as drawbacks.
Autonomy	Students are capable of independently solving mechanical engineering problems using provided literature. They are able to fill gaps in as well as extent their knowledge using the literature and other sources provided by the supervisor. Furthermore, they can meaningfully extend given problems and pragmatically solve them by means of corresponding solutions and concepts.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Materials Science: Specialisation Engineering Materials: Elective Compulsory Mechanical Engineering and Management: Specialisation Materials: 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

Course L1895: Processing of fibre-polymer-composites	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler
Language	DE/EN
Cycle	SoSe
Content	Manufacturing of Composites: Hand Lay-Up; Pre-Preg; GMT, BMC; SMC, RIM; Pultrusion; Filament Winding
Literature	Åström: Manufacturing of Polymer Composites, Chapman and Hall

Course L1516: From Molecule to Composites Part	
Typ	Project-/problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler
Language	DE/EN
Cycle	SoSe
Content	Students get the task in the form of a customer request for the development and production of a MTB handlebar made of fiber composites. In the task technical and normative requirements (standards) are given, all other required information come from the lectures and tutorials, and the respective documents (electronically and in conversation). The procedure is to specify in a milestone schedule and allows students to plan tasks and to work continuously. At project end, each group has a made handlebar with approved quality. In each project meeting the design (discussion of the requirements and risks) are discussed. The calculations are analyzed, evaluated and established manufacturing methods are selected. Materials are selected bar will be produced. The quality and the mechanical properties are checked. At the end of the final report created (compilation of the results for the "customers"). After the test during the "customer / supplier conversation" there is a mutual feedback-talk ("lessons learned") in order to ensure the continuous improvement.
Literature	Customer Request ("Handout")

Module M1343: Fibre-polymer-composites

Courses

Title	Typ	Hrs/wk	CP
Structure and properties of fibre-polymer-composites (L1894)	Lecture	2	3
Design with fibre-polymer-composites (L1893)	Lecture	2	3

Module Responsible	Prof. Bodo Fiedler
Admission Requirements	None
Recommended Previous Knowledge	Basics: chemistry / physics / materials science
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can use the knowledge of fiber-reinforced composites (FRP) and its constituents to play (fiber / matrix) and define the necessary testing and analysis. They can explain the complex relationships structure-property relationship and the interactions of chemical structure of the polymers, their processing with the different fiber types, including to explain neighboring contexts (e.g. sustainability, environmental protection).
Skills	Students are capable of • using standardized calculation methods in a given context to mechanical properties (modulus, strength) to calculate and evaluate the different materials. • approximate sizing using the network theory of the structural elements implement and evaluate. • selecting appropriate solutions for mechanical recycling problems and sizing example stiffness, corrosion resistance.
Personal Competence	
Social Competence	Students can • arrive at funded work results in heterogenius groups and document them. • provide appropriate feedback and handle feedback on their own performance constructively.
Autonomy	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. - assess possible consequences of their professional activity.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	180 min
Assignment for the Following Curricula	Energy Systems: Core Qualification: Elective Compulsory Aircraft Systems Engineering: Specialisation Cabin Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Air Transportation Systems: Elective Compulsory International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Materials Science: Specialisation Engineering Materials: Elective Compulsory Mechanical Engineering and Management: 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 Renewable Energies: Specialisation Bioenergy Systems: Elective Compulsory Renewable Energies: Specialisation Wind Energy Systems: Elective Compulsory Renewable Energies: Specialisation Solar Energy Systems: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Materials Science: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

Course L1894: Structure and properties of fibre-polymer-composites	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler
Language	EN
Cycle	SoSe
Content	- Microstructure and properties of the matrix and reinforcing materials and their interaction - Development of composite materials - Mechanical and physical properties - Mechanics of Composite Materials - Laminate theory - Test methods - Non destructive testing - Failure mechanisms - Theoretical models for the prediction of properties - Application
Literature	Hall, Clyne: Introduction to Composite materials, Cambridge University Press Daniel, Ishai: Engineering Mechanics of Composites Materials, Oxford University Press Mallick: Fibre-Reinforced Composites, Marcel Deckker, New York

Course L1893: Design with fibre-polymer-composites	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler
Language	EN
Cycle	SoSe
Content	Designing with Composites: Laminate Theory; Failure Criteria; Design of Pipes and Shafts; Sandwich Structures; Notches; Joining Techniques; Compression Loading; Examples
Literature	Konstruieren mit Kunststoffen, Gunter Erhard , Hanser Verlag

Module M1174: Automation Technology and Systems

Courses

Title	Typ	Hrs/wk	CP
Automation Technology and Systems (L2329)	Lecture	4	4
Automation Technology and Systems (L2331)	Project-/problem-based Learning	1	1
Automation Technology and Systems (L2330)	Recitation Section (small)	1	1

Module Responsible	Prof. Thorsten Schüppstuhl
Admission Requirements	None
Recommended Previous Knowledge	without major course assessment
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students • know the characteristic components of an automation systems and have good understanding of their interaction • know methods for a systematical analysis of automation tasks and are able to use them • have special competences in industrial robot based automation systems
Skills	Students are able to... • analyze complex Automation tasks • develop application based concepts and solutions • design subsystems and integrate into one system • investigate and evaluate safety of machinery • create simple programs for robots and programmable logic controllers • design of circuit for pneumatic applications
Personal Competence	
Social Competence	Students are able to ... - find solutions for automation and handling tasks in groups - develop solutions in a production environment with qualified personnel at technical level and represent decisions.
Autonomy	Students are able to ... • analyze automation tasks independently • generate programs for robots and programmable logic devices autonomously • develop solutions for practice oriented tasks of automation independently • design safety concepts for automation applications • assess consequences of their professional actions and responsibilities
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Production: Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory

Course L2329: Automation Technology and Systems

Typ	Lecture
Hrs/wk	4
CP	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	
Literature	

Course L2331: Automation Technology and Systems	
Typ	Project-/problem-based Learning
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L2330: Automation Technology and Systems	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0563: Robotics

Courses

Title	Typ	Hrs/wk	CP
Robotics: Modelling and Control (L0168)	Lecture	3	3
Robotics: Modelling and Control (L1305)	Recitation Section (large)	2	3

Module Responsible	Prof. Uwe Weltin
Admission Requirements	None
Recommended Previous Knowledge	Fundamentals of electrical engineering Broad knowledge of mechanics Fundamentals of control theory
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to describe fundamental properties of robots and solution approaches for multiple problems in robotics.
Skills	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.
Personal Competence	
Social Competence	Students are able to work goal-oriented in small mixed groups.
Autonomy	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.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	Aircraft Systems Engineering: Specialisation Aircraft Systems: 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Robotics and Computer Science: Elective Compulsory

Course L0168: Robotics: Modelling and Control

Typ	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Dr. Martin Gomse, Prof. Uwe Weltin
Language	EN
Cycle	WiSe
Content	Fundamental kinematics of rigid body systems Newton-Euler equations for manipulators Trajectory generation Linear and nonlinear control of robots
Literature	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	
Typ	Recitation Section (large)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Martin Gomse, Prof. Uwe Weltin
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0771: Flight Physics

Courses

Title	Typ	Hrs/wk	CP
Aerodynamics and Flight Mechanics I (L0727)	Lecture	3	3
Flight Mechanics II (L0730)	Lecture	2	2
Flight Mechanics II (L0731)	Recitation Section (large)	1	1

Module Responsible	Prof. Frank Thielecke
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Aviation
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	
Skills	
Personal Competence	
Social Competence	
Autonomy	
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 Minutes (WS) + 90 Minutes (SS)
Assignment for the Following Curricula	Aircraft Systems Engineering: Core Qualification: Compulsory International Management and Engineering: Specialisation II. Aviation Systems: 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 Aircraft Systems Engineering: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

Course L0727: Aerodynamics and Flight Mechanics I

Typ	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Frank Thielecke, Dr. Ralf Heinrich, Mike Montel
Language	DE
Cycle	WiSe
Content	• Aerodynamics (fundamental equations of aerodynamics; compressible and incompressible flows; airfoils and wings; viscous flows) • Flight Mechanics (Equations of motion; flight performance; control surfaces; derivatives; lateral stability and control; trim conditions; flight maneuvers)
Literature	• Schlichting, H.; Truckenbrodt, E.: Aerodynamik des Flugzeuges I und II • Etkin, B.: Dynamics of Atmospheric Flight • Sachs/Hafer: Flugmechanik • Brockhaus: Flugregelung • J.D. Anderson: Introduction to flight

Course L0730: Flight Mechanics II	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Frank Thielecke, Mike Montel
Language	DE
Cycle	SoSe
Content	• stationary asymmetric flight • dynamics of lateral movement • methods of flight simulation • eyperimental methods of flight mechanics • model validation using system identification • wind tunnel techniques
Literature	• Schlichting, H.; Truckenbrodt, E.: Aerodynamik des Flugzeuges I und II • Etkin, B.: Dynamics of Atmospheric Flight • Sachs/Hafer: Flugmechanik • Brockhaus: Flugregelung • J.D. Anderson: Introduction to flight

Course L0731: Flight Mechanics II	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Frank Thielecke, Mike Montel
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0815: Product Planning

Courses

Title	Typ	Hrs/wk	CP
Product Planning (L0851)	Project-/problem-based Learning	3	3
Product Planning Seminar (L0853)	Project-/problem-based Learning	2	3

Module Responsible	Prof. Cornelius Herstatt
Admission Requirements	None
Recommended Previous Knowledge	Good basic-knowledge of Business Administration
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	

Knowledge	Students will gain insights into:
	• Product Planning
	  ◦ Process
	  ◦ Methods
	• Design thinking
	  ◦ Process
	  ◦ Methods
	  ◦ User integration

Skills	Students will gain deep insights into:
	• Product Planning
	  ◦ Process-related aspects
	  ◦ Organisational-related aspects
	  ◦ Human-Ressource related aspects
	  ◦ Working-tools, methods and instruments
	  ◦

Personal Competence	
Social Competence	• Interact within a team • Raise awareness for globabl issues
Autonomy	• Gain access to knowledge sources • Interpret complex cases • Develop presentation skills
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	**Compulsory** / **Bonus** / **Form** / **Description** Yes / 20 % / Subject theoretical and practical work /
Examination	Written exam
Examination duration and scale	90 minutes
Assignment for the Following Curricula	Global Innovation Management: Core Qualification: Compulsory International Management and Engineering: Specialisation I. Electives Management: Elective Compulsory Mechanical Engineering and Management: Specialisation 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 Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

Course L0851: Product Planning	
Typ	Project-/problem-based Learning
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Cornelius Herstatt
Language	EN
Cycle	WiSe
Content	Product Planning Process 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.: • Systematic scanning of markets for innovation opportunities • Understanding strengths/weakness and specific core competences of a firm as platforms for innovation • Exploring relevant sources for innovation (customers, suppliers, Lead Users, etc.) • Developing ideas for radical innovation, relying on the creativeness of employees, using techniques to stimulate creativity and creating a stimulating environment • Transferring ideas for innovation into feasible concepts which have a high market attractively Voluntary presentations in the third hour (articles / case studies) - Guest lectures by researchers - Lecture on Sustainability with frequent reference to current research - Permanent reference to current research Examination: In addition to the written exam at the end of the module, students have to attend the PBL-exercises and prepare presentations in groups in order to pass the module. Additionally, students have the opportunity to present research papers on a voluntary base. With these presentations it is possible to gain a bonus of max. 20% for the exam. However, the bonus is only valid if the exam is passed without the bonus.
Literature	Ulrich, K./Eppinger, S.: Product Design and Development, 2nd. Edition, McGraw-Hill 2010

Course L0853: Product Planning Seminar	
Typ	Project-/problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Cornelius Herstatt
Language	EN
Cycle	WiSe
Content	Seminar is integrative part of the Module Product Planning (for content see lecture) and can not be choosen independantly.
Literature	See lecture information "Product Planning".

Module M0830: Environmental Protection and Management

Courses

Title	Typ	Hrs/wk	CP
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

Module Responsible	Prof. Ralf Otterpohl
Admission Requirements	None
Recommended Previous Knowledge	• Good knowledge in Technologies for Environmental Protection (end-of-pipe, integrated solutions) • Good knowledge of the relevant Environmental Legislation • Basic knowledge of instruments for Environmental Assessment
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	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.
Skills	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.
Personal Competence	
Social Competence	The students can work together in international groups.
Autonomy	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.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Bioprocess Engineering: Specialisation C - Bioeconomic Process Engineering, Focus Management and Controlling: Elective Compulsory Energy and Environmental Engineering: Specialisation Environmental Engineering: Elective Compulsory Environmental Engineering: Core Qualification: 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	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	WiSe
Content	The lecture focusses on: • The Regulatory Framework • Pollution & Impacts, Characteristics of Pollutants • Approaches of Integrated Pollution Control • Sevilla Process, Best Available Technologies & BREF Documents • Case Studies: paper industry, cement industry, automotive industry • Field Trip
Literature	**Förstner**, Ulrich (1998): Integrated Pollution Control, Springer-Verlag Berlin Heidelberg, ISBN 978-3-642-80313-0 **Shen**, Thomas T. (1999): Industrial Pollution Prevention, Springer-Verlag Berlin Heidelberg, ISBN 978-3-540-65208-3

Course L0387: Health, Safety and Environmental Management	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Hans-Joachim Nau
Language	EN
Cycle	WiSe
Content	• 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
Literature	C. Stephan: Industrial Health, Safety and Environmental Management, MV-Verlag, Münster, 2007/2012 (can be found in the library under GTG 315) Exercises can be downloaded from StudIP

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

Module M0867: Production Planning & Control and Digital Enterprise

Courses

Title	Typ	Hrs/wk	CP
The Digital Enterprise (L0932)	Lecture	2	2
Production Planning and Control (L0929)	Lecture	2	2
Production Planning and Control (L0930)	Recitation Section (small)	1	1
Exercise: The Digital Enterprise (L0933)	Recitation Section (small)	1	1

Module Responsible	Prof. Hermann Lödding
Admission Requirements	None
Recommended Previous Knowledge	Fundamentals of Production and Quality Management
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can explain the contents of the module in detail and take a critical position to them.
Skills	Students are capable of choosing and applying models and methods from the module to industrial problems.
Personal Competence	
Social Competence	Students can develop joint solutions in mixed teams and present them to others.
Autonomy	-
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	180 Minuten
Assignment for the Following Curricula	International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Logistics, Infrastructure and Mobility: Specialisation Production and Logistics: 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: Compulsory Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Production: 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 L0932: The Digital Enterprise

Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Axel Friedewald
Language	DE
Cycle	WiSe
Content	Due to the developments of Industry 4.0, digitalization and interconnectivity become a strategic advantage for companies in the international competition. This lecture focuses on the relevant modules and enables the participants to evaluate current developments in this context. In particular, knowledge management, simulation, process modelling and virtual technologies are covered. Content: • Business Process Management and Data Modelling, Simulation • Knowledge and Competence Management • Process Management (PPC, Workflow Management) • Computer Aided Planning (CAP) and NC-Programming • Virtual Reality (VR) and Augmented Reality (AR) • Computer Aided Quality Management (CAQ) • Industry 4.0
Literature	Scheer, A.-W.: ARIS - vom Geschäftsprozeß zum Anwendungssystem. Springer-Verlag, Berlin 4. Aufl. 2002 Schuh, G. et. al.: Produktionsplanung und -steuerung, Springer-Verlag. Berlin 3. Auflage 2006 Becker, J.; Luczak, H.: Workflowmanagement in der Produktionsplanung und -steuerung. Springer-Verlag, Berlin 2004 Pfeifer, T; Schmitt, R.: Masing Handbuch Qualitätsmanagement. Hanser-Verlag, München 5. Aufl. 2007 Kühn, W.: Digitale Fabrik. Hanser-Verlag, München 2006

Course L0929: Production Planning and Control	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	WiSe
Content	• Models of Production and Inventory Management • Production Programme Planning and Lot Sizing • Order and Capacity Scheduling • Selected Strategies of PPC • Manufacturing Control • Production Controlling • Supply Chain Management
Literature	• Vorlesungsskript • Lödding, H: Verfahren der Fertigungssteuerung, Springer 2008 • Nyhuis, P.; Wiendahl, H.-P.: Logistische Kennlinien, Springer 2002

Course L0930: Production Planning and Control	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L0933: Exercise: The Digital Enterprise	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Axel Friedewald
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	Siehe korrespondierende Vorlesung See interlocking course

Module M0962: Sustainability and Risk Management

Courses

Title	Typ	Hrs/wk	CP
Safety, Reliability and Risk Assessment (L1145)	Seminar	2	3
Environment and Sustainability (L0319)	Lecture	2	3

Module Responsible	Prof. Kerstin Kuchta
Admission Requirements	None
Recommended Previous Knowledge	none
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to describe single techniques and to give an overview for the field of safety and risk assessment as well as environmental and sustainable engineering, in detail: • basics in safety and reliability of technical facilities • safety and reliability analysis methods • risk assessment • Production and usage of bio-char • energy production and supply • sustainable product design
Skills	Students are able apply interdisciplinary system-oriented methods for risk assessment and sustainability reporting. They can evaluate the effort and costs for processes and select economically feasible treatment concepts.
Personal Competence	
Social Competence	
Autonomy	Students can gain knowledge of the subject area from given sources and transform it to new questions. Furthermore, they can define targets for new application or research-oriented duties in for risk management and sustainability concepts accordance with the potential social, economic and cultural impact.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and scale	Elaboration and presentation (45 minutes in groups)
Assignment for the Following Curricula	Civil Engineering: Core Qualification: Compulsory Bioprocess Engineering: Specialisation C - Bioeconomic Process Engineering, Focus Management and Controlling: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: 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: Core Qualification: Compulsory

Course L1145: Safety, Reliability and Risk Assessment

Typ	Seminar
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Marco Ritzkowski
Language	DE
Cycle	WiSe
Content	An introduction in safety and risk assessment is given and some typical problems of structural and environmental engineering are treated: • basics in safety and reliability of technical facilities • safety and reliability analysis methods • risk assessment • practical examples and excursions • discussions and presentations
Literature	- Vorlesungsunterlagen - Schneider, J., Schlatter, H.P.: Sicherheit und Zuverlässigkeit im Bauwesen. www.risksafety.ch/files/**sicherheit**_und_zuverlaessigkeit.pdf

Course L0319: Environment and Sustainability	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Kerstin Kuchta
Language	EN
Cycle	WiSe
Content	This course presents actual methodologies and examples of environmental relevant, sustainable technologies, concepts and strategies in the field of energy supply, product design, water supply, waste water treatment or mobility. The following list show examples. Production and Usage of Bio-char Engergy production with algae Environmental product design Clean Development mechanism (CDM) Democracy and Energy New Concepts for a sustainable Energy Supply Recycling of Wind Turbines Alternative Mobility Disposal of Nuclear Wastes Waste2Energy Offshore Wind energy
Literature	Wird in der Veranstaltung bekannt gegeben.

Module M1155: Aircraft Cabin Systems

Courses

Title	Typ	Hrs/wk	CP
Aircraft Cabin Systems (L1545)	Lecture	3	4
Aircraft Cabin Systems (L1546)	Recitation Section (large)	1	2

Module Responsible	Prof. Ralf God
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Electrical Engineering • Control Systems
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to: • describe cabin operations, equipment in the cabin and cabin Systems • explain the functional and non-functional requirements for cabin Systems • elucidate the necessity of cabin operating systems and emergency Systems • assess the challenges human factors integration in a cabin environment
Skills	Students are able to: • design a cabin layout for a given business model of an Airline • design cabin systems for safe operations • design emergency systems for safe man-machine interaction • solve comfort needs and entertainment requirements in the cabin
Personal Competence	
Social Competence	Students are able to: • understand existing system solutions and discuss their ideas with experts
Autonomy	Students are able to: • Reflect the contents of lectures and expert presentations self-dependent
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 Minutes
Assignment for the Following Curricula	Electrical Engineering: Specialisation Control and Power Systems Engineering: Elective Compulsory Energy Systems: Specialisation Energy Systems: Elective Compulsory Aircraft Systems Engineering: Core Qualification: Compulsory International Management and Engineering: Specialisation II. Aviation Systems: 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 Aircraft Systems Engineering: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

Course L1545: Aircraft Cabin Systems	
Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Ralf God
Language	DE
Cycle	WiSe
Content	The objective of the lecture with the corresponding exercise is the acquisition of knowledge about aircraft cabin systems and cabin operations. A basic understanding of technological and systems engineering effort to maintain an artificial but comfortable and safe travel and working environment at cruising altitude is to be achieved. The course provides a comprehensive overview of current technology and cabin systems in modern passenger aircraft. The Fulfillment of requirements for the cabin as the central system of work are covered on the basis of the topics comfort, ergonomics, human factors, operational processes, maintenance and energy supply: • Materials used in the cabin • Ergonomics and human factors • Cabin interior and non-electrical systems • Cabin electrical systems and lights • Cabin electronics, communication-, information- and IFE-systems • Cabin and passenger process chains • RFID Aircraft Parts Marking • Energy sources and energy conversion
Literature	- Skript zur Vorlesung - Jenkinson, L.R., Simpkin, P., Rhodes, D.: Civil Jet Aircraft Design. London: Arnold, 1999 - Rossow, C.-C., Wolf, K., Horst, P. (Hrsg.): Handbuch der Luftfahrzeugtechnik. Carl Hanser Verlag, 2014 - Moir, I., Seabridge, A.: Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration, Wiley 2008 - Davies, M.: The standard handbook for aeronautical and astronautical engineers. McGraw-Hill, 2003 - Kompendium der Flugmedizin. Verbesserte und ergänzte Neuauflage, Nachdruck April 2006. Fürstenfeldbruck, 2006 - Campbell, F.C.: Manufacturing Technology for Aerospace Structural Materials. Elsevier Ltd., 2006

Course L1546: Aircraft Cabin Systems	
Typ	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Ralf God
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1183: Laser systems and methods of manufacturing design and analysis

Courses			
Title	**Typ**	**Hrs/wk**	**CP**
Laser Systems and Process Technologies (L1612)	Lecture	2	3
Methods for Analysing Production Processes (L0876)	Lecture	2	3

Module Responsible	Prof. Wolfgang Hintze
Admission Requirements	None
Recommended Previous Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	
Skills	
Personal Competence	
Social Competence	
Autonomy	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	180 min
Assignment for the Following Curricula	Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Production: 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 L1612: Laser Systems and Process Technologies

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Claus Emmelmann
Language	EN
Cycle	WiSe
Content	• Fundamentals of laser technology • Laser beam sources: CO2-, Nd:YAG-, Fiber- and Diodelasers • Laser system technology: beam forming, beam guidance systems, beam motion and beam control • Laser-based manufacturing technologies: generation, marking, cutting, joining, surface treatment • Quality assurance and economical aspects of laser material processing • Markets and Applications of laser technology • Student group exercises
Literature	• Hügel, H. , T. Graf: Laser in der Fertigung : Strahlquellen, Systeme, Fertigungsverfahren, 3. Aufl., Vieweg + Teubner Wiesbaden 2014. • Eichler, J., Eichler. H. J.: Laser: Bauformen, Strahlführung, Anwendungen, 7. Aufl., Springer-Verlag Berlin Heidelberg 2010. • Steen W. M.; Mazumder J.: Laser material processing, 4th Edition, Springer-Verlag London 2010. • J.C. Ion: Laser processing of engineering materials: principles, procedure and industrial applications, Elsevier Butterworth-Heinemann 2005. • Gebhardt, A.: Understanding additive manufacturing, München [u.a.] Hanser 2011

Course L0876: Methods for Analysing Production Processes	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hintze
Language	DE
Cycle	WiSe
Content	• Modelling and simulation of maching and forming processes • Numerical simulation of forces, temperatures, deformation in machining • Analysis of vibration problems in maching (chatter, modal analysis,..) • Knowledge based process planning • Design of experiments • Machinability of nonmetallic materials • Analysis of interaction between maching process and machine tool systems with regard to process stabiltity and quality • Simulation of maching processes by virtual reality methods
Literature	Tönshoff, H.K.; Denkena, B.; Spanen Grundlagen, Springer (2004) Klocke, F.; König, W.; Fertigungsverfahren Umformen, Springer (2006) Weck, M.; Werkzeugmaschinen Fertigungssysteme 3, Springer (2001) Weck, M.; Werkzeugmaschinen Fertigungssysteme 5, Springer (2001)

Module M1342: Polymers

Courses

Title	Typ	Hrs/wk	CP
Structure and Properties of Polymers (L0389)	Lecture	2	3
Processing and design with polymers (L1892)	Lecture	2	3

Module Responsible	Dr. Hans Wittich
Admission Requirements	None
Recommended Previous Knowledge	Basics: chemistry / physics / material science
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can use the knowledge of plastics and define the necessary testing and analysis. They can explain the complex relationships structure-property relationship and the interactions of chemical structure of the polymers, including to explain neighboring contexts (e.g. sustainability, environmental protection).
Skills	Students are capable of - using standardized calculation methods in a given context to mechanical properties (modulus, strength) to calculate and evaluate the different materials. - selecting appropriate solutions for mechanical recycling problems and sizing example stiffness, corrosion resistance.
Personal Competence	
Social Competence	Students can - arrive at funded work results in heterogenius groups and document them. - provide appropriate feedback and handle feedback on their own performance constructively.
Autonomy	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. - assess possible consequences of their professional activity.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	180 min
Assignment for the Following Curricula	Materials Science: Specialisation Engineering Materials: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Materials Science: Elective Compulsory

Course L0389: Structure and Properties of Polymers	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Hans Wittich
Language	DE
Cycle	WiSe
Content	- Structure and properties of polymers - Structure of macromolecules Constitution, Configuration, Conformation, Bonds, Synthesis, Molecular weihght distribution - Morphology amorph, crystalline, blends - Properties Elasticity, plasticity, viscoelacity - Thermal properties - Electrical properties - Theoretical modelling - Applications
Literature	Ehrenstein: Polymer-Werkstoffe, Carl Hanser Verlag

Course L1892: Processing and design with polymers	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler, Dr. Hans Wittich
Language	DE/EN
Cycle	WiSe
Content	Manufacturing of Polymers: General Properties; Calendering; Extrusion; Injection Moulding; Thermoforming, Foaming; Joining Designing with Polymers: Materials Selection; Structural Design; Dimensioning
Literature	Osswald, Menges: Materials Science of Polymers for Engineers, Hanser Verlag Crawford: Plastics engineering, Pergamon Press Michaeli: Einführung in die Kunststoffverarbeitung, Hanser Verlag Konstruieren mit Kunststoffen, Gunter Erhard , Hanser Verlag

Module M0812: Aircraft Design

Courses

Title	Typ	Hrs/wk	CP
Aircraft Design I (Design of Transport Aircraft) (L0820)	Lecture	2	2
Aircraft Design II (Conceptual Design of Rotorcraft, special operations aircraft, UAV) (L0844)	Lecture	2	2
Aircraft Design II (Conceptual Design of Rotorcraft, special operations aircraft, UAV) (L0847)	Recitation Section (large)	1	1
Aircraft Design I (L0834)	Recitation Section (large)	1	1

Module Responsible	Prof. Volker Gollnick
Admission Requirements	None
Recommended Previous Knowledge	• Bachelor Mech. Eng. • Vordiplom Mech. Eng. • Module Air Transport Systems
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	1. Principle understanding of integrated aircraft design 2. Understanding of the interactions and contributions of the various disciplines 3. Impact of the relevant design parameter on the aircraft design 4. Introduction of the principle design methods
Skills	Understanding and application of design and calculation methods Understanding of interdisciplinary and integrative interdependencies
Personal Competence	
Social Competence	Working in interdisciplinary teams Communication
Autonomy	Organization of workflows and -strategies
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	Aircraft Systems Engineering: Core Qualification: Compulsory International Management and Engineering: Specialisation II. Aviation Systems: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory

Course L0820: Aircraft Design I (Design of Transport Aircraft)

Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Volker Gollnick
Language	DE
Cycle	WiSe
Content	Introduction into the aircraft design process 1. Introduction/process of aircraft design/various aircraft configurations 2. Requirements and design objectives, main design parameter (u.a. payload-range-diagramme) 3. Statistical methods in overall aircraft design/data base methods 4. Principles of aircraft performance design (stability, V-n-diagramme) 5. Principles of aerodynamic aircraft design (polar, geometry, 2D/3D aerodynamics) 6. Principles of structural fuselage and wing design (mass analysis, beam/tube models, geometry) 7. Principles of engine design and integration 8. Cruise design 9. Design of runway and landing field length 10. Cabin design (fuselage dimensioning, cabin interior, loading systems) 11. System- and equipment aspects 12. Design variations and operating cost calculation
Literature	J. Roskam: "Airplane Design" D.P. Raymer: "Aircraft Design - A Conceptual Approach" J.P. Fielding: "Intorduction to Aircraft Design" Jenkinson, Simpkon, Rhods: "Civil Jet Aircraft Design"

Course L0844: Aircraft Design II (Conceptual Design of Rotorcraft, special operations aircraft, UAV)	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Volker Gollnick, Dr. Bernd Liebhardt
Language	DE/EN
Cycle	SoSe
Content	Take Off and landing Loads on Aircraft Operation Cost Principles of Rotorcraft Design Principles of high performance aircraft design Principles of special operations aircraft design Principles of Unmanned Air Systems design
Literature	Gareth Padfield: Helicopter Flight Dynamics Raymond Prouty: Helicopter Performance Stability and Control Klaus Hünecke: Das Kampfflugzeug von Heute

Course L0847: Aircraft Design II (Conceptual Design of Rotorcraft, special operations aircraft, UAV)	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Volker Gollnick, Dr. Bernd Liebhardt
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0834: Aircraft Design I	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Volker Gollnick
Language	DE
Cycle	WiSe
Content	Training in applying MatLab Application of design methods for civil aircraft concerning: Fuselage and Cabin sizing and design Calculation of aircraft masses Aerodynamic and geometric wing design TakeOff, landing cruise performance calculation Manoevre and gust load calculation
Literature	J. Roskam: "Airplane Design" D.P. Raymer: "Aircraft Design - A Conceptual Approach" J.P. Fielding: "Intorduction to Aircraft Design" Jenkinson, Simpkon, Rhods: "Civil Jet Aircraft Design"

Module M1185: Technical Complementary Course for PEPMS (according to Subject Specific Regulations)

Courses			
Title	**Typ**	**Hrs/wk**	**CP**

Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous Knowledge	See selected module according to FSPO
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	see selected module according to FSPO
Skills	see selected module according to FSPO
Personal Competence	
Social Competence	see selected module according to FSPO
Autonomy	see selected module according to FSPO
Workload in Hours	Depends on choice of courses
Credit points	6
Assignment for the Following Curricula	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

Specialization Production

Graduates of the discipline production have in-depth knowledge of various production and manufacturing processes. They are qualified to evaluate those in the context of geometry creation, error control, cost effectiveness and humanization of work and are able to consider the interfaces of technology, organization and human, holistically.

Module M0763: Aircraft Systems I

Courses

Title	Typ	Hrs/wk	CP
Aircraft Systems I (L0735)	Lecture	3	4
Aircraft Systems I (L0739)	Recitation Section (large)	2	2

Module Responsible	Prof. Frank Thielecke
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Electrical Engineering • Hydraulics • Control Systems
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to: • Describe essential components and design points of hydraulic, electrical and high-lift systems • Give an overview of the functionality of air conditioning systems • Explain the need for high-lift systems such as ist functionality and effects • Assess the challenge during the design of supply systems of an aircraft
Skills	Students are able to: • Design hydraulic and electric supply systems of aircrafts • Design high-lift systems of aircrafts • Analyze the thermodynamic behaviour of air conditioning systems
Personal Competence	
Social Competence	Students are able to: • Perform system design in groups and present and discuss results
Autonomy	Students are able to: • Reflect the contents of lectures autonomously
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	165 Minutes
Assignment for the Following Curricula	Energy Systems: Specialisation Energy Systems: Elective Compulsory Aircraft Systems Engineering: Core Qualification: Compulsory International Management and Engineering: Specialisation II. Aviation Systems: 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory

Course L0735: Aircraft Systems I	
Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	WiSe
Content	• Hydraulic Energy Systems (Fluids; pressure loss in valves and pipes; components of hydraulic systems like pumps, valves, etc.; pressure/flow characteristics; actuators; tanks; power and heat balances; emergency power) • Electric Energy Systems (Generators; constant-speed-drives; DC and AC converters; electrical power distribution; bus systems; monitoring; load analysis) • High Lift Systems (Principles; investigation of loads and system actuation power; principles and sizing of actuation and positioning systems; safety requirements and devices) • Environmental Control Systems (Thermodynamic analysis; expansion and compression cooling systems; control strategies; cabin pressure control systems)
Literature	• Moir, Seabridge: Aircraft Systems • Green: Aircraft Hydraulic Systems • Torenbek: Synthesis of Subsonic Airplane Design • SAE1991: ARP; Air Conditioning Systems for Subsonic Airplanes

Course L0739: Aircraft Systems I	
Typ	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0867: Production Planning & Control and Digital Enterprise

Courses

Title	Typ	Hrs/wk	CP
The Digital Enterprise (L0932)	Lecture	2	2
Production Planning and Control (L0929)	Lecture	2	2
Production Planning and Control (L0930)	Recitation Section (small)	1	1
Exercise: The Digital Enterprise (L0933)	Recitation Section (small)	1	1

Module Responsible	Prof. Hermann Lödding
Admission Requirements	None
Recommended Previous Knowledge	Fundamentals of Production and Quality Management
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can explain the contents of the module in detail and take a critical position to them.
Skills	Students are capable of choosing and applying models and methods from the module to industrial problems.
Personal Competence	
Social Competence	Students can develop joint solutions in mixed teams and present them to others.
Autonomy	-
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	180 Minuten
Assignment for the Following Curricula	International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Logistics, Infrastructure and Mobility: Specialisation Production and Logistics: 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: Compulsory Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Production: 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 L0932: The Digital Enterprise

Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Axel Friedewald
Language	DE
Cycle	WiSe
Content	Due to the developments of Industry 4.0, digitalization and interconnectivity become a strategic advantage for companies in the international competition. This lecture focuses on the relevant modules and enables the participants to evaluate current developments in this context. In particular, knowledge management, simulation, process modelling and virtual technologies are covered. Content: • Business Process Management and Data Modelling, Simulation • Knowledge and Competence Management • Process Management (PPC, Workflow Management) • Computer Aided Planning (CAP) and NC-Programming • Virtual Reality (VR) and Augmented Reality (AR) • Computer Aided Quality Management (CAQ) • Industry 4.0
Literature	Scheer, A.-W.: ARIS - vom Geschäftsprozeß zum Anwendungssystem. Springer-Verlag, Berlin 4. Aufl. 2002 Schuh, G. et. al.: Produktionsplanung und -steuerung, Springer-Verlag. Berlin 3. Auflage 2006 Becker, J.; Luczak, H.: Workflowmanagement in der Produktionsplanung und -steuerung. Springer-Verlag, Berlin 2004 Pfeifer, T; Schmitt, R.: Masing Handbuch Qualitätsmanagement. Hanser-Verlag, München 5. Aufl. 2007 Kühn, W.: Digitale Fabrik. Hanser-Verlag, München 2006

Course L0929: Production Planning and Control	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	WiSe
Content	• Models of Production and Inventory Management • Production Programme Planning and Lot Sizing • Order and Capacity Scheduling • Selected Strategies of PPC • Manufacturing Control • Production Controlling • Supply Chain Management
Literature	• Vorlesungsskript • Lödding, H: Verfahren der Fertigungssteuerung, Springer 2008 • Nyhuis, P.; Wiendahl, H.-P.: Logistische Kennlinien, Springer 2002

Course L0930: Production Planning and Control	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L0933: Exercise: The Digital Enterprise	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Axel Friedewald
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	Siehe korrespondierende Vorlesung See interlocking course

Module M1183: Laser systems and methods of manufacturing design and analysis

Courses

Title	Typ	Hrs/wk	CP
Laser Systems and Process Technologies (L1612)	Lecture	2	3
Methods for Analysing Production Processes (L0876)	Lecture	2	3

Module Responsible	Prof. Wolfgang Hintze
Admission Requirements	None
Recommended Previous Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	
Skills	
Personal Competence	
Social Competence	
Autonomy	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	180 min
Assignment for the Following Curricula	Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Production: 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 L1612: Laser Systems and Process Technologies

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Claus Emmelmann
Language	EN
Cycle	WiSe
Content	• Fundamentals of laser technology • Laser beam sources: CO2-, Nd:YAG-, Fiber- and Diodelasers • Laser system technology: beam forming, beam guidance systems, beam motion and beam control • Laser-based manufacturing technologies: generation, marking, cutting, joining, surface treatment • Quality assurance and economical aspects of laser material processing • Markets and Applications of laser technology • Student group exercises
Literature	• Hügel, H. , T. Graf: Laser in der Fertigung : Strahlquellen, Systeme, Fertigungsverfahren, 3. Aufl., Vieweg + Teubner Wiesbaden 2014. • Eichler, J., Eichler. H. J.: Laser: Bauformen, Strahlführung, Anwendungen, 7. Aufl., Springer-Verlag Berlin Heidelberg 2010. • Steen W. M.; Mazumder J.: Laser material processing, 4th Edition, Springer-Verlag London 2010. • J.C. Ion: Laser processing of engineering materials: principles, procedure and industrial applications, Elsevier Butterworth-Heinemann 2005. • Gebhardt, A.: Understanding additive manufacturing, München [u.a.] Hanser 2011

Course L0876: Methods for Analysing Production Processes	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hintze
Language	DE
Cycle	WiSe
Content	• Modelling and simulation of maching and forming processes • Numerical simulation of forces, temperatures, deformation in machining • Analysis of vibration problems in maching (chatter, modal analysis,..) • Knowledge based process planning • Design of experiments • Machinability of nonmetallic materials • Analysis of interaction between maching process and machine tool systems with regard to process stabiltity and quality • Simulation of maching processes by virtual reality methods
Literature	Tönshoff, H.K.; Denkena, B.; Spanen Grundlagen, Springer (2004) Klocke, F.; König, W.; Fertigungsverfahren Umformen, Springer (2006) Weck, M.; Werkzeugmaschinen Fertigungssysteme 3, Springer (2001) Weck, M.; Werkzeugmaschinen Fertigungssysteme 5, Springer (2001)

Module M1193: Cabin Systems Engineering

Courses

Title	Typ	Hrs/wk	CP
Computer and communication technology in cabin electronics and avionics (L1557)	Lecture	2	2
Computer and communication technology in cabin electronics and avionics (L1558)	Recitation Section (small)	1	1
Model-Based Systems Engineering (MBSE) with SysML/UML (L1551)	Project-/problem-based Learning	3	3

Module Responsible	Prof. Ralf God
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Electrical Engineering • Control Systems Previous knowledge in: • Systems Engineering
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to: • describe the structure and operation of computer architectures • explain the structure and operation of digital communication Networks • explain architectures of cabin electronics, integrated modular avionics (IMA) and Aircraft Data Communication Network (ADCN) • understand the approach of Model-Based Systems Engineering (MBSE) in the design of hardware and software-based cabin systems
Skills	Students are able to: • understand, operate and maintain a Minicomputer • build up a network communication and communicate with other network participants • connect a minicomputer with a cabin management system (A380 CIDS) and communicate over a AFDX®-Network • model system functions by means of formal languages SysML/UML and generate software code from the models • execute software code on a minicomputer
Personal Competence	
Social Competence	Students are able to: • elaborate partial results and merge with others to form a complete solution
Autonomy	Students are able to: • organize and schedule their practical tasks
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 minutes
Assignment for the Following Curricula	Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Air Transportation Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Cabin Systems: Compulsory International Management and Engineering: Specialisation II. Aviation Systems: 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory

Course L1557: Computer and communication technology in cabin electronics and avionics	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf God
Language	DE
Cycle	WiSe
Content	The objective of the lecture with the corresponding exercise is the acquisition of knowledge of computer and communication technology in electronic systems in the cabin and in aircraft. For the system engineer the strong interaction of software, mechanical and electronic system components nowadays requires a basic understanding of cabin electronics and avionics. The course teaches the basics of design and functionality of computers and data networks. Subsequently it focuses on current principles and applications in integrated modular avionics (IMA), aircraft data communication networks (ADCN), cabin electronics and cabin networks: • History of computer and network technology • Layer model in computer technology • Computer architectures (PC, IPC, Embedded Systems) • BIOS, UEFI and operating system (OS) • Programming languages (machine code and high-level languages) • Applications and Application Programming Interfaces • External interfaces (serial, USB, Ethernet) • Layer model in network technology • Network topologies • Network components • Bus access procedures • Integrated Modular Avionics (IMA) and Aircraft Data Communication Networks (ADCN) • Cabin electronics and cabin networks
Literature	- Skript zur Vorlesung - Schnabel, P.: Computertechnik-Fibel: Grundlagen Computertechnik, Mikroprozessortechnik, Halbleiterspeicher, Schnittstellen und Peripherie. Books on Demand; 1. Auflage, 2003 - Schnabel, P.: Netzwerktechnik-Fibel: Grundlagen, Übertragungstechnik und Protokolle, Anwendungen und Dienste, Sicherheit. Books on Demand; 1. Auflage, 2004 - Wüst, K.: Mikroprozessortechnik: Grundlagen, Architekturen und Programmierung von Mikroprozessoren, Mikrocontrollern und Signalprozessoren. Vieweg Verlag; 2. aktualisierte und erweiterte Auflage, 2006

Course L1558: Computer and communication technology in cabin electronics and avionics	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Ralf God
Language	DE
Cycle	WiSe
Content	The objective of the lecture with the corresponding exercise is the acquisition of knowledge of computer and communication technology in electronic systems in the cabin and in aircraft. For the system engineer the strong interaction of software, mechanical and electronic system components nowadays requires a basic understanding of cabin electronics and avionics. The course teaches the basics of design and functionality of computers and data networks. Subsequently it focuses on current principles and applications in integrated modular avionics (IMA), aircraft data communication networks (ADCN), cabin electronics and cabin networks: • History of computer and network technology • Layer model in computer technology • Computer architectures (PC, IPC, Embedded Systems) • BIOS, UEFI and operating system (OS) • Programming languages (machine code and high-level languages) • Applications and Application Programming Interfaces • External interfaces (serial, USB, Ethernet) • Layer model in network technology • Network topologies • Network components • Bus access procedures • Integrated Modular Avionics (IMA) and Aircraft Data Communication Networks (ADCN) • Cabin electronics and cabin networks
Literature	- Skript zur Vorlesung - Schnabel, P.: Computertechnik-Fibel: Grundlagen Computertechnik, Mikroprozessortechnik, Halbleiterspeicher, Schnittstellen und Peripherie. Books on Demand; 1. Auflage, 2003 - Schnabel, P.: Netzwerktechnik-Fibel: Grundlagen, Übertragungstechnik und Protokolle, Anwendungen und Dienste, Sicherheit. Books on Demand; 1. Auflage, 2004 - Wüst, K.: Mikroprozessortechnik: Grundlagen, Architekturen und Programmierung von Mikroprozessoren, Mikrocontrollern und Signalprozessoren. Vieweg Verlag; 2. aktualisierte und erweiterte Auflage, 2006

Course L1551: Model-Based Systems Engineering (MBSE) with SysML/UML	
Typ	Project-/problem-based Learning
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Ralf God, Dr. Sylvia Melzer
Language	DE
Cycle	SoSe
Content	Objectives of the problem-oriented course are the acquisition of knowledge on system design using the formal languages SysML/UML, learning about tools for modeling and finally the implementation of a project with methods and tools of Model-Based Systems Engineering (MBSE) on a realistic hardware platform (e.g. Arduino®, Raspberry Pi®): • What is a model? • What is Systems Engineering? • Survey of MBSE methodologies • The modelling languages SysML /UML • Tools for MBSE • Best practices for MBSE • Requirements specification, functional architecture, specification of a solution • From model to software code • Validation and verification: XiL methods • Accompanying MBSE project
Literature	- Skript zur Vorlesung - Weilkiens, T.: Systems Engineering mit SysML/UML: Modellierung, Analyse, Design. 2. Auflage, dpunkt.Verlag, 2008 - Holt, J., Perry, S.A., Brownsword, M.: Model-Based Requirements Engineering. Institution Engineering & Tech, 2011

Module M0511: Electricity Generation from Wind and Hydro Power

Courses

Title	Typ	Hrs/wk	CP
Renewable Energy Projects in Emerged Markets (L0014)	Project Seminar	1	1
Hydro Power Use (L0013)	Lecture	1	1
Wind Turbine Plants (L0011)	Lecture	2	3
Wind Energy Use - Focus Offshore (L0012)	Lecture	1	1

Module Responsible	Dr. Joachim Gerth
Admission Requirements	None
Recommended Previous Knowledge	Module: Technical Thermodynamics I, Module: Technical Thermodynamics II, Module: Fundamentals of Fluid Mechanics
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	By ending this module students can explain in detail knowledge of wind turbines with a particular focus of wind energy use in offshore conditions and can critical comment these aspects in consideration of current developments. Furthermore, they are able to describe fundamentally the use of water power to generate electricity. The students reproduce and explain the basic procedure in the implementation of renewable energy projects in countries outside Europe. Through active discussions of various topics within the seminar of the module, students improve their understanding and the application of the theoretical background and are thus able to transfer what they have learned in practice.
Skills	Students are able to apply the acquired theoretical foundations on exemplary water or wind power systems and evaluate and assess technically the resulting relationships in the context of dimensioning and operation of these energy systems. They can in compare critically the special procedure for the implementation of renewable energy projects in countries outside Europe with the in principle applied approach in Europe and can apply this procedure on exemplary theoretical projects.
Personal Competence	
Social Competence	Students can discuss scientific tasks subjet-specificly and multidisciplinary within a seminar.
Autonomy	Students can independently exploit sources in the context of the emphasis of the lecture material to clear the contents of the lecture and to acquire the particular knowledge about the subject area.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	3 hours written exam
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Energy and Environmental Engineering: Specialisation Energy Engineering: Elective Compulsory International Management and Engineering: Specialisation II. Renewable Energy: Elective Compulsory International Management and Engineering: Specialisation II. Energy and Environmental Engineering: 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 Renewable Energies: Core Qualification: Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory Water and Environmental Engineering: Specialisation Environment: Compulsory Water and Environmental Engineering: Specialisation Cities: Elective Compulsory

Course L0014: Renewable Energy Projects in Emerged Markets	
Typ	Project Seminar
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Andreas Wiese
Language	DE
Cycle	SoSe
Content	1. Introduction ◦ Development of renewable energies worldwide ▪ History ▪ Future markets ◦ Special challenges in new markets - Overview 2. Sample project wind farm Korea ◦ Survey ◦ Technical Description ◦ Project phases and characteristics 3. Funding and financing instruments for EE projects in new markets ◦ Overview funding opportunitie ◦ Overview countries with feed-in laws ◦ Major funding programs 4. CDM projects - why, how , examples ◦ Overview CDM process ◦ Examples ◦ Exercise CDM 5. Rural electrification and hybrid systems - an important future market for EE ◦ Rural Electrification - Introduction ◦ Types of Elektrizifierungsprojekten ◦ The role of the EEInterpretation of hybrid systems ◦ Project example: hybrid system Galapagos Islands 6. Tendering process for EE projects - examples ◦ South Africa ◦ Brazil 7. Selected projects from the perspective of a development bank - Wesley Urena Vargas, KfW Development Bank ◦ Geothermal ◦ Wind or CSP Within the seminar, the various topics are actively discussed and applied to various cases of application.
Literature	Folien der Vorlesung

Course L0013: Hydro Power Use	
Typ	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Stefan Achleitner
Language	DE
Cycle	SoSe
Content	• Introduction, importance of water power in the national and global context • Physical basics: Bernoulli's equation, usable height of fall, hydrological measures, loss mechanisms, efficiencies • Classification of Hydropower: Flow and Storage hydropower, low and high pressure systems • Construction of hydroelectric power plants: description of the individual components and their technical system interaction • Structural engineering components; representation of dams, weirs, dams, power houses, computer systems, etc. • Energy Technical Components: Illustration of the different types of hydraulic machinery, generators and grid connection • Hydropower and the Environment • Examples from practice
Literature	• Schröder, W.; Euler, G.; Schneider, K.: Grundlagen des Wasserbaus; Werner, Düsseldorf, 1999, 4. Auflage • Quaschning, V.: Regenerative Energiesysteme: Technologie - Berechnung - Simulation; Carl Hanser, München, 2011, 7. Auflage • Giesecke, J.; Heimerl, S.; Mosony, E.: Wasserkraftanlagen - Planung, Bau und Betrieb; Springer, Berlin, Heidelberg, 2009, 5. Auflage • von König, F.; Jehle, C.: Bau von Wasserkraftanlagen - Praxisbezogene Planungsunterlagen; C. F. Müller, Heidelberg, 2005, 4. Auflage • Strobl, T.; Zunic, F.: Wasserbau: Aktuelle Grundlagen - Neue Entwicklungen; Springer, Berlin, Heidelberg, 2006

Course L0011: Wind Turbine Plants	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Rudolf Zellermann, Dr. Jochen Oexmann
Language	DE
Cycle	SoSe
Content	• Historical development • Wind: origins, geographic and temporal distribution, locations • Power coefficient, rotor thrust • Aerodynamics of the rotor • Operating performance • Power limitation, partial load, pitch and stall control • Plant selection, yield prediction, economy • Excursion
Literature	Gasch, R., Windkraftanlagen, 4. Auflage, Teubner-Verlag, 2005

Course L0012: Wind Energy Use - Focus Offshore	
Typ	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Martin Skiba
Language	DE
Cycle	SoSe
Content	• Introduction, importance of offshore wind power generation, Specific requirements for offshore engineering • Physical fundamentals for utilization of wind energy • Design and operation of offshore wind turbines, presentation of different concepts of offshore wind turbines, representation of the individual system components and their system-technical relationships • Foundation engineering, offshore site investigation, presentation of different concepts of offshore foundation structures, planning and fabrication of foundation structures • Electrical infrastructure of an offshore wind farm, Inner Park cabling, offshore substation, grid connection • Installation of offshore wind farms, installation techniques and auxiliary devices, construction logistics • Development and planning of offshore wind farms • Operation and optimization of offshore wind farms • Day excursion
Literature	• Gasch, R.; Twele, J.: Windkraftanlagen - Grundlagen, Entwurf, Planung und Betrieb; Vieweg + Teubner, Stuttgart, 2007, 7. Auflage • Molly, J. P.: Windenergie - Theorie, Anwendung, Messung; C. F. Müller, Heidel-berg, 1997, 3. Auflage • Hau, E.: Windkraftanalagen; Springer, Berlin, Heidelberg, 2008, 4.Auflage • Heier, S.: Windkraftanlagen - Systemauslegung, Integration und Regelung; Vieweg + Teubner, Stuttgart, 2009, 5. Auflage • Jarass, L.; Obermair, G.M.; Voigt, W.: Windenergie: Zuverlässige Integration in die Energieversorgung; Springer, Berlin, Heidelberg, 2009, 2. Auflage

Module M0630: Robotics and Navigation in Medicine

Courses

Title	Typ	Hrs/wk	CP
Robotics and Navigation in Medicine (L0335)	Lecture	2	3
Robotics and Navigation in Medicine (L0338)	Project Seminar	2	2
Robotics and Navigation in Medicine (L0336)	Recitation Section (small)	1	1

Module Responsible	Prof. Alexander Schlaefer
Admission Requirements	None
Recommended Previous Knowledge	• principles of math (algebra, analysis/calculus) • principles of programming, e.g., in Java or C++ • solid R or Matlab skills
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students can explain kinematics and tracking systems in clinical contexts and illustrate systems and their components in detail. Systems can be evaluated with respect to collision detection and safety and regulations. Students can assess typical systems regarding design and limitations.
Skills	The students are able to design and evaluate navigation systems and robotic systems for medical applications.
Personal Competence	
Social Competence	The students discuss the results of other groups, provide helpful feedback and can incoorporate feedback into their work.
Autonomy	The students can reflect their knowledge and document the results of their work. They can present the results in an appropriate manner.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	**Compulsory** / **Bonus** / **Form** / **Description** Yes / 10 % / Written elaboration Yes / 10 % / Presentation
Examination	Written exam
Examination duration and scale	90 minutes
Assignment for the Following Curricula	Computer Science: Specialisation Intelligence Engineering: Elective Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory International Management and Engineering: Specialisation II. Electrical Engineering: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: 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 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Bio- and Medical Technology: Elective Compulsory

Course L0335: Robotics and Navigation in Medicine

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Alexander Schlaefer
Language	EN
Cycle	SoSe
Content	- kinematics - calibration - tracking systems - navigation and image guidance - motion compensation The seminar extends and complements the contents of the lecture with respect to recent research results.
Literature	Spong et al.: Robot Modeling and Control, 2005 Troccaz: Medical Robotics, 2012 Further literature will be given in the lecture.

Course L0338: Robotics and Navigation in Medicine	
Typ	Project Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Alexander Schlaefer
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0336: Robotics and Navigation in Medicine	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Alexander Schlaefer
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0764: Aircraft Systems II

Courses

Title	Typ	Hrs/wk	CP
Aircraft Systems II (L0736)	Lecture	3	4
Aircraft Systems II (L0740)	Recitation Section (large)	2	2

Module Responsible	Prof. Frank Thielecke
Admission Requirements	None
Recommended Previous Knowledge	basic knowledge of: • mathematics • mechanics • thermo dynamics • electronics • fluid technology • control technology
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to... • describe the structure of primary flight control systems as well as actuation-, avionic-, fuel- and landing gear-systems in general along with corresponding properties and applications. • explain different configurations and designs and their origins • explain atmospheric conditions for icing such as the functionality of anti-ice systems
Skills	Students are able to... • size primary flight control actuation systems • perform a controller design process for the flight control actuators • design high-lift kinematics • design and analyse landing gear systems • design anti-ice systems
Personal Competence	
Social Competence	Students are able to: • Develop joint solutions in mixed teams
Autonomy	Students are able to: • derive requirements and perform appropriate yet simplified design processes for aircraft systems from complex issues and circumstances in a self-reliant manner
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	165 Minutes
Assignment for the Following Curricula	Aircraft Systems Engineering: Core Qualification: Compulsory International Management and Engineering: Specialisation II. Aviation Systems: 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory

Course L0736: Aircraft Systems II	
Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	SoSe
Content	• Actuation (Principles of actuators; electro-mechanical actuators; modeling, analysis and sizing of position control systems; hydro-mechanic actuation systems) • Flight Control Systems (control surfaces, hinge moments; requirements of stability and controllability, actuation power; principles of reversible and irreversible flight control systems; servo actuation systems) • Landing Gear Systems (Configurations and geometries; analysis of landing gear systems with respect to damper dynamics, dynamics of the breaking aircraft and power consumption; design and analysis of breaking systems with respect to energy and heat; anti-skit systems) • Fuel Systems (Architectures; aviation fuels; system components; fueling system; tank inerting system; fuel management; trim tank) • De- and Anti-Ice Systems: (Atmospheric icing conditions; principles of de- and anti-ice systems)
Literature	• Moir, Seabridge: Aircraft Systems • Torenbek: Synthesis of Subsonic Airplane Design • Curry: Aircraft Landing Gear Design: Principles and Practices

Course L0740: Aircraft Systems II	
Typ	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0811: Medical Imaging Systems

Courses

Title	Typ	Hrs/wk	CP
Medical Imaging Systems (L0819)	Lecture	4	6

Module Responsible	Dr. Michael Grass
Admission Requirements	None
Recommended Previous Knowledge	none
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can: • Describe the system configuration and components of the main clinical imaging systems; • Explain how the system components and the overall system of the imaging systems function; • Explain and apply the physical processes that make imaging possible and use with the fundamental physical equations; • Name and describe the physical effects required to generate image contrasts; • Explain how spatial and temporal resolution can be influenced and how to characterize the images generated; • Explain which image reconstruction methods are used to generate images; Describe and explain the main clinical uses of the different systems.

Skills	Students are able to:
	• Explain the physical processes of images and assign to the systems the basic mathematical or physical equations required;
	  ◦ Calculate the parameters of imaging systems using the mathematical or physical equations;
	  ◦ Determine the influence of different system components on the spatial and temporal resolution of imaging systems;
	  ◦ Explain the importance of different imaging systems for a number of clinical applications;
	Select a suitable imaging system for an application.

Personal Competence	
Social Competence	none
Autonomy	Students can: • Understand which physical effects are used in medical imaging; • Decide independently for which clinical issue a measuring system can be used.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Biomedical Engineering: 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Bio- and Medical Technology: Elective Compulsory

Course L0819: Medical Imaging Systems

Typ	Lecture
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Dr. Michael Grass, Dr. Tim Nielsen, Dr. Sven Prevrhal, Frank Michael Weber
Language	DE
Cycle	SoSe
Content	
Literature	Primary book: 1. P. Suetens, "Fundamentals of Medical Imaging", Cambridge Press Secondary books: - A. Webb, "Introduction to Biomedical Imaging", IEEE Press 2003. - W.R. Hendee and E.R. Ritenour, "Medical Imaging Physics", Wiley-Liss, New York, 2002. - H. Morneburg (Edt), "Bildgebende Systeme für die medizinische Diagnostik", Erlangen: Siemens Publicis MCD Verlag, 1995. - O. Dössel, "Bildgebende Verfahren in der Medizin", Springer Verlag Berlin, 2000.

Module M1141: Selected Topics of Product Development, Materials Science and Production (Alternative A: 12 LP)

Courses

Title	Typ	Hrs/wk	CP
Applied Automation (L1592)	Project-/problem-based Learning	3	3
Ergonomics (L0653)	Lecture	2	3
Elements of Integrated Production Systems (L0927)	Project-/problem-based Learning	2	3
Emotional Design / User Centered Product Development (L1703)	Seminar	2	2
Development Management for Mechatronics (L1512)	Lecture	2	3
Fatigue & Damage Tolerance (L0310)	Lecture	2	3
Industry 4.0 for engineers (L2012)	Lecture	2	3
Innovation and Product Management (L2168)	Seminar	2	3
Lightweight Construction with Fibre Reinforced Rolymers - Structural Mechanics (L1514)	Lecture	2	3
Lightweight Design Practical Course (L1258)	Project-/problem-based Learning	3	3
Mechanisms, Systems and Processes of Materials Testing (L0950)	Lecture	2	2
Microsystems Technology (L0724)	Lecture	2	4
Productivity Management (L0928)	Project-/problem-based Learning	2	2
Productivity Management (L0931)	Recitation Section (small)	1	1
Feedback Control in Medical Technology (L0664)	Lecture	2	3
Renewable Energy (L0313)	Lecture	2	2
Renewable Energy (L1434)	Recitation Section (small)	1	1
Six Sigma (L1130)	Lecture	2	3
System Simulation (L1820)	Lecture	2	2
System Simulation (L1821)	Recitation Section (large)	1	2
Technical Design (L1513)	Lecture	2	3
Ceramics Technology (L0379)	Lecture	2	3
Materials Testing (L0949)	Lecture	2	2
Reliability in Engineering Dynamics (L0176)	Lecture	2	2
Reliability in Engineering Dynamics (L1303)	Recitation Section (small)	1	2
Reliability of Aircraft Systems (L0749)	Lecture	2	3

Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous Knowledge	None
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students are able to express their extended knowledge and discuss the connection of different special fields or application areas of product development, materials and production • Students are qualified to connect different special fields with each other
Skills	• Students can apply specialized solution strategies and new scientific methods in selected areas • Students are able to transfer learned skills to new and unknown problems and can develop own solution approaches
Personal Competence	
Social Competence	-
Autonomy	• Students are able to develop their knowledge and skills by autonomous election of courses.
Workload in Hours	Depends on choice of courses
Credit points	12
Assignment for the Following Curricula	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

Course L1592: Applied Automation	
Typ	Project-/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 Minuten
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	-Project Based Learning -Robot Operating System -Robot structure and description -Motion description -Calibration -Accuracy
Literature	John J. Craig Introduction to Robotics – Mechanics and Control ISBN: 0131236296 Pearson Education, Inc., 2005 Stefan Hesse Grundlagen der Handhabungstechnik ISBN: 3446418725 München Hanser, 2010 K. Thulasiraman and M. N. S. Swamy Graphs: Theory and Algorithms ISBN: 9781118033104 John Wüey & Sons, Inc., 1992

Course L0653: Ergonomics	
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	30 Minuten
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	

Course L0927: Elements of Integrated Production Systems	
Typ	Project-/problem-based Learning
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. Hermann Lödding
Language	DE
Cycle	SoSe
Content	not available
Literature	Harris, R.; Harris, C.; Wilson, E.: Making Materials Flow, Lean Enterprise Institute, Cambridge, 2003. Ohno, T.: Das Toyota-Produktionssystem, Campus-Verlag, Frankfurt et al, 1993. Rother, M.: Die Kata des Weltmarktführers. Toyotas Erfolgsmethoden, Campus-Verlag, Frankfurt et al, 2009. Rother, M.; Shook, J.: Sehen lernen: Mit Wertstromdesign die Wertschöpfung erhöhen und Verschwendung beseitigen, Lean Management Institut, Aachen, 2006. Rother, M.; Harris, R.: Creating Continuous Flow, Lean Enterprise Institute, Brookline, 2001. Shingo, S.: A Revolution in Manufacturing. The SMED System, Productivity Press, 2006. Womack, J. P. et al: Die zweite Revolution in der Autoindustrie, Frankfurt/New York, Campus Verlag, 1992.

Course L1703: Emotional Design / User Centered Product Development	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	Teamarbeit und abschließender Vortrag
Lecturer	Jörg Heuser
Language	DE
Cycle	SoSe
Content	Lecture • Objective and subjective perception for the evaluation of product characteristics • Effects of material, color, shape and structure to the acceptance of a product • Aesthetic function of a product • Case studies, lack of acceptance of a product and possible reason Seminar • Identification of non-technical product functions • Identification of subjective influences for the product development Project Work • Topics will be developed in cooperation with the students. Project works will be presented in teams, presented and evaluated Exemplary Project: Holistic product evaluation, product optimization
Literature	Wird in der Veranstaltung angegeben

Course L1512: Development Management for Mechatronics	
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	30 Minuten
Lecturer	Dr. Daniel Steffen
Language	DE
Cycle	SoSe

Content	• Processes and methods of product development - from idea to market launch
	  ◦ identification of market and technology potentials
	  ◦ development of a common product architecture
	  ◦ Synchronized product development across all engineering disciplines
	  ◦ product validation incl. customer view
	• Steering and optimization of product development
	  ◦ Design of processes for product development
	  ◦ IT systems for product development
	  ◦ Establishment of management standards
	  ◦ Typical types of organization

Literature	• Bender: Embedded Systems - qualitätsorientierte Entwicklung • Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit • Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen • Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung • Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden • Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung • VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme

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. Kluver Academic Puplisher, Dordrecht, 2001 E. Haibach. Betriebsfestigkeit Verfahren und Daten zur Bauteilberechnung. VDI-Verlag, Düsseldorf, 1989

Course L2012: Industry 4.0 for engineers	
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 min
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	
Literature	

Course L2168: Innovation and Product Management	
Typ	Seminar
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	30 min
Lecturer	Dr. Christoph Fuchs
Language	DE
Cycle	SoSe
Content	
Literature	

Course L1514: Lightweight Construction with Fibre Reinforced Rolymers - Structural Mechanics	
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	30 min
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	WiSe
Content	**Fundamentals of Anisotropic Elasticity** Displacements, strains and stresses; Equilibrium equations; Kinematics; Hooke's generalized law **Behaviour of a single laminate layer** Material law of a single laminate layer; Full anisotropy and coupling effects; Material symmetries; Engineering constants; Plane state of stress; Transformation rules **Fundamentals of Micromechanics of a laminate layer** Representative unit cell; Determination of effective material constants; Effective stiffness properties of a single layer **Classical Laminate Plate Theory** Notations and laminate code; Kinematics and displacement field; Strains and stresses, stress resultants; Constitutive equations and coupling effects; Special laminates and their behavior; Effective laminate properties **Strength of Laminated Plates** Fundamental concept; Phenomenological failure criteria: maximum stresses, maximum strains, Tsai-Hill, Tsai-Wu, Puck, Hashin **Bending of Composite Laminated Plates** Differential Equations; Boundary Conditions; Navier-type solutions; Lévy-type solutions **Stress Concentration Problems** Free-edge effects; Stress concentrations at holes, cracks, delaminations; Aspects of failure analysis **Stability of Thin-Walled Composite Structures** Buckling of anisotropic plates and shells; Influence of loading conditions; Influence of boundary conditions; Exact transcendental solutions and their evaluation; Buckling of stiffened composite plates; Minimum stiffness requirements; Local buckling of stiffener profiles **Written exercise (report required)** Assessment of a thin-walled composite laminated beam taking several different dimensioning criteria into account
Literature	• Schürmann, H., „Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage. • Wiedemann, J., „Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage. • Reddy, J.N., „Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al., current edition. • Jones, R.M., „Mechanics of Composite Materials", Scripta Book Co., Washington, current edition. • Timoshenko, S.P., Gere, J.M., „Theory of elastic stability", McGraw-Hill Book Company, Inc., New York, current edition. • Turvey, G.J., Marshall, I.H., „Buckling and postbuckling of composite plates", Chapman and Hall, London, current edition. • Herakovich, C.T., „Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition. • Mittelstedt, C., Becker, W., „Strukturmechanik ebener Laminate", aktuelle Auflage.

Course L1258: Lightweight Design Practical Course	
Typ	Project-/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/EN
Cycle	SoSe
Content	Development of a sandwich structure made of fibre reinforced plastics • getting familiar with fibre reinforced plastics as well as lightweight design • Design of a sandwich structure made of fibre reinforced plastics using finite element analysis (FEA) • Determination of material properties based on sample tests • manufacturing of the structure in the composite lab • Testing of the developed structure • Concept presentation • Self-organised teamwork
Literature	• Schürmann, H., „Konstruieren mit Faser-Kunststoff-Verbunden“, Springer, Berlin, 2005. • Puck, A., „Festigkeitsanalsyse von Faser-Matrix-Laminaten“, Hanser, München, Wien, 1996. • R&G, „Handbuch Faserverbundwerkstoffe“, Waldenbuch, 2009. • VDI 2014 „Entwicklung von Bauteilen aus Faser-Kunststoff-Verbund“ • Ehrenstein, G. W., „Faserverbundkunststoffe“, Hanser, München, 2006. • Klein, B., „Leichtbau-Konstruktion", Vieweg & Sohn, Braunschweig, 1989. • Wiedemann, J., „Leichtbau Band 1: Elemente“, Springer, Berlin, Heidelberg, 1986. • Wiedemann, J., „Leichtbau Band 2: Konstruktion“, Springer, Berlin, Heidelberg, 1986. • Backmann, B.F., „Composite Structures, Design, Safety and Innovation”, Oxford (UK), Elsevier, 2005. • Krause, D., „Leichtbau”, In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012. • Schulte, K., Fiedler, B., „Structure and Properties of Composite Materials”, Hamburg, TUHH - TuTech Innovation GmbH, 2005.

Course L0950: Mechanisms, Systems and Processes of Materials Testing	
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	Dr. Jan Oke Peters
Language	DE
Cycle	SoSe
Content	Application, analysis and discussion of basic and advanced testing methods to ensure correct selection of applicable testing procedure for investigation of part/materials deficiencies • Stress-strain relationships • Strain gauge application • Visko elastic behavior • Tensile test (strain hardening, necking, strain rate) • Compression test, bending test, torsion test • Crack growth upon static loading (J-Integral) • Crack growth upon cyclic loading (micro- und macro cracks) • Effect of notches • Creep testing (physical creep test, influence of stress and temperature, Larson Miller parameter) • Wear testing • Non destructive testing application for overhaul of jet engines
Literature	• E. Macherauch: Praktikum in Werkstoffkunde, Vieweg • G. E. Dieter: Mechanical Metallurgy, McGraw-Hill • R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg • R. Bürgel: Werkstoffe sícher beurteilen und richtig einsetzen, Vieweg

Course L0724: Microsystems Technology	
Typ	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cycle	WiSe
Content	• Introduction (historical view, scientific and economic relevance, scaling laws) • Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution, next-generation lithography, nano-imprinting, molecular imprinting) • Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVD, LPCVD, PECVD and LECVD; screen printing) • Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA, electrochemical etching, anisotropic etching with KOH/TMAH: theory, corner undercutting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering, plasma etching, RIE, Bosch process, cryo process, XeF2 etching) • Surface Micromachining and alternative Techniques (sacrificial etching, film stress, stiction: theory and counter measures; Origami microstructures, Epi-Poly, porous silicon, SOI, SCREAM process, LIGA, SU8, rapid prototyping) • Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensors: thermo resistor, Pt-100, spreading resistance sensor, pn junction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry, IR sensor: thermopile and bolometer) • Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistivity, pressure sensor: piezoresistive, capacitive and fabrication process; accelerometer: piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process) • Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensors: magneto resistance, AMR and GMR, fluxgate magnetometer) • Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; metal oxide semiconductor gas sensor, organic semiconductor gas sensor, Lambda probe, MOSFET gas sensor, pH-FET, SAW sensor, principle of biosensor, Clark electrode, enzyme electrode, DNA chip) • Micro Actuators, Microfluidics and TAS (drives: thermal, electrostatic, piezo electric and electromagnetic; light modulators, DMD, adaptive optics, microscanner, microvalves: passive and active, micropumps, valveless micropump, electrokinetic micropumps, micromixer, filter, inkjet printhead, microdispenser, microfluidic switching elements, microreactor, lab-on-a-chip, microanalytics) • MEMS in medical Engineering (wireless energy and data transmission, smart pill, implantable drug delivery system, stimulators: microelectrodes, cochlear and retinal implant; implantable pressure sensors, intelligent osteosynthesis, implant for spinal cord regeneration) • Design, Simulation, Test (development and design flows, bottom-up approach, top-down approach, testability, modelling: multiphysics, FEM and equivalent circuit simulation; reliability test, physics-of-failure, Arrhenius equation, bath-tub relationship) • System Integration (monolithic and hybrid integration, assembly and packaging, dicing, electrical contact: wire bonding, TAB and flip chip bonding; packages, chip-on-board, wafer-level-package, 3D integration, wafer bonding: anodic bonding and silicon fusion bonding; micro electroplating, 3D-MID)
Literature	M. Madou: Fundamentals of Microfabrication, CRC Press, 2002 N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009 T. M. Adams, R. A. Layton:Introductory MEMS, Springer, 2010 G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008

Course L0928: Productivity Management	
Typ	Project-/problem-based Learning
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. Hermann Lödding
Language	DE
Cycle	SoSe
Content	• Principles of productivity management • Shop floor management and standardisation • Takt analysis and design of manual operations • Maintenance Principles • Total Productive Maintenance (TPM) • Optimisation of set-up operations • Analysis of interlinked production systems
Literature	Bokranz, R.; Landau, K.:Produktivitätsmanagement von Arbeitssystemen. Schäffer-Poeschel, Stuttgart, 2006. Takeda, H.: Das synchrone Produktionssystem: Just-in-Time für das ganze Unternehmen. 5. Aufl., mi-Wirtschaftsbuch, FinanzBuch Verlag, München, 2006. Nakajima, S.: Management der Produktionseinrichtungen (Total Productive Maintenance). Campus Verlag, New York, 1995. Shingo, S.: A Revolution in Manufacturing: The SMED System. Productivity, Inc., 1985

Course L0931: Productivity Management	
Typ	Recitation Section (small)
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. Hermann Lödding
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0664: Feedback Control in Medical Technology	
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	20 min
Lecturer	Johannes Kreuzer, Christian Neuhaus
Language	DE
Cycle	SoSe
Content	Always viewed from the engineer's point of view, the lecture is structured as follows: • Introduction to the topic • Fundamentals of physiological modelling • Introduction to Breathing and Ventilation • Physiology and Pathology in Cardiology • Introduction to the Regulation of Blood Glucose • kidney function and renal replacement therapy • Representation of the control technology on the concrete ventilator • Excursion to a medical technology company Techniques of modeling, simulation and controller development are discussed. In the models, simple equivalent block diagrams for physiological processes are derived and explained how sensors, controllers and actuators are operated. MATLAB and SIMULINK are used as development tools.
Literature	• Leonhardt, S., & Walter, M. (2016). Medizintechnische Systeme. Berlin, Heidelberg: Springer Vieweg. • Werner, J. (2005). Kooperative und autonome Systeme der Medizintechnik. München: Oldenbourg. • Oczenski, W. (2017). Atmen : Atemhilfen ; Atemphysiologie und Beatmungstechnik: Georg Thieme Verlag KG.

Course L0313: Renewable Energy	
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. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	• introduction • solar energy for heat and power generation • wind power for electricity generation • hydropower for electricity generation • ocean energy for electricity generation • geothermal energy for heat and electricty generation
Literature	• Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage • Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg,2007

Course L1434: Renewable Energy	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	60 Minuten
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	Students work on different tasks in the field of renewable energies. They present their solutions in the exercise lesson and discuss it with other students and the lecturer. Possible tasks in the field of renewable energies are: • Solar thermal heat • Concentrating solare power • Photovoltaic • Windenergie • Hydropower • Heat pump • Deep geothermal energy
Literature	• Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage • Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg,2007

Course L1130: Six Sigma	
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. Claus Emmelmann
Language	DE
Cycle	WiSe
Content	• Introduction and structuring • Basic terms of quality management • Measuring and inspection equipment • Tools of quality management: FMEA, QFD, FTA, etc. • Quality management methodology Six Sigma, DMAIC
Literature	Pfeifer, T.: Qualitätsmanagement : Strategien, Methoden, Techniken, 4. Aufl., München 2008 Pfeifer, T.: Praxishandbuch Qualitätsmanagement, München 1996 Geiger, W., Kotte, W.: Handbuch Qualität : Grundlagen und Elemente des Qualitätsmanagements: Systeme, Perspektiven, 5. Aufl., Wiesbaden 2008

Course L1820: System Simulation	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Stefan Wischhusen
Language	DE
Cycle	WiSe
Content	All participants must bring a notebook, to install and use the software OpenModelica. • Instruction and modelling of physical processes • Modelling and limits of model • Time constant, stiffness, stability, step size • Terms of object orientated programming • Differential equations of simple systems • Introduction into Modelica • Introduction into simulation tool • Example: Heat transfer • Example: System with different subsystems
Literature	[1] Modelica Association: "Modelica Language Specification - Version 3.3", Linköping, Sweden, 2 0 1 2 [2] M. Tiller: "Modelica by Example", http://book.xogeny.com, 2014. [3] M. Otter, H. Elmqvist, et al.: "Objektorientierte Modellierung Physikalischer Systeme", at- Automatisierungstechnik (german), Teil 1 - 17, Oldenbourg Verlag, 1999 - 2000. [4] P. Fritzson: "Principles of Object-Oriented Modeling and Simulation with Modelica 3.3", Wiley-IEEE Press, New York, 2015. [5] P. Fritzson: "Introduction to Modeling and Simulation of Technical and Physical Systems with Modelica", Wiley, New York, 2011.

Course L1821: System Simulation	
Typ	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Stefan Wischhusen
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1513: Technical Design	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	10-15 Entwurfszeichnungen, Skizzen und ca. 5-10 A4-Dokumentationsseiten (Themen- und Entwurfsbegründung)
Lecturer	Prof. Werner Granzeier
Language	DE
Cycle	SoSe
Content	• Basics with analysis, concept, proposal drawings and sketches • Samples from practice of technical industrial design • Product concept with new ideas and package • ID proposal with structural concept and external product ergonomics • Visualisation and presentation of the overall concept • Realization as individual case studies
Literature	Literatur über technisches Produktdesign Technisches Rendering und Präsentation

Zeichnen und perspektivisches Entwerfen

Literaturhinweise

What is Product Design ?

Laura Slack

RotoVision Schweiz 2006

Product Design Now

Design and Scetches

CollinsDesign and maomao publications Spanien 2006

Ronald B. Kemnitzer, Rendering With Markers - Definitive Techniques

for Designers, Illustrators and Architects,

Watson, Guptil Puplications,a division of Billboard Publications Inc.,

New York 1983

Creative Techniques

DRAWING

Barons Educational Series

ISBN-13: 978-0-7641-6182-7

Joseph Ungar, Rendering In Mixed Media - Techniques for Concept

Presentation for Designers and Illustrators

Watson-Guptil Publication a division of Billboard Publications Inc.,

New York 1985

AIRWORLD

Design und Architektur für die Flugreise

Vitra Design Stiftung   Weil am Rhein 2004

Airline Design

Perter Deslius Jacek Slaski te Neues 2005

Technik und Sicherheit von Passagierflugzeugen

Frank Littek

Motorbuch Verlag 2003

Jetliner Cabins

Jennifer Coutts Clay

Cs books   England 2006

BOEING Widebodies

Michael Haenggi   motorbooks international USA 2003

form - Zeitschrift für Gestaltung, Verlag form GmbH,

Hofgut Ober-Berrbach, 6104 Seeheim-Jugenheim

(erscheint vierteljährlich, Verlag form GmbH)

design report

german magasin,

(erscheint monatlich)

md - möbel interior design, Konradin-Verlag

Robert Kohlhammer GmbH, 7022 Leinfelden-Echterdingen

(erscheint monatlich)

CAR STYLING, Car Styling Publishing Co. 4-8-16-11F,

Kitashinjuku, Shinjuku-ku, Tokio 160, Japan

(erscheint vierteljährlich in japanischer und englischer Sprache, in Hamburg erhältlich bei: Overseas Courier Service Deutschland GmbH,

Auto & Design,

Corso Frabcia 161, 10139 Torino, Italia

	(erscheint vierteljährlich in italienischer und englischer Sprache alle zwei Monate , erhältlich am HBF Hamburg AERO International, Magazin für Zivilluftfahrt (erscheint monatlich) Aircraft interior international Engl. magasin for Aircraft cabin interior (erscheint 2 monatlich) aerotec Technik- und Branchenmagazin für die Luft- und Raumfahrtindustrie

Course L0379: Ceramics Technology	
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	Dr. Rolf Janßen
Language	DE/EN
Cycle	WiSe
Content	Introduction to ceramic processing with emphasis on advanced structural ceramics. The course focus predominatly on powder-based processing, e.g. “powder-metauurgical techniques and sintering (soild state and liquid phase). Also, some aspects of glass and cement science as well as new developments in powderless forming techniques of ceramics and ceramic composites will be addressed Examples will be discussed in order to give engineering students an understanding of technology development and specific applications of ceramic components. **Content:** 1. Introduction Inhalt: 2. Raw materials 3. Powder fabrication 4. Powder processing 5. Shape-forming processes 6. Densification, sintering 7. Glass and Cement technology 8. Ceramic-metal joining techniques
Literature	W.D. Kingery, „Introduction to Ceramics“, John Wiley & Sons, New York, 1975 ASM Engineering Materials Handbook Vol.4 „Ceramics and Glasses“, 1991 D.W. Richerson, „Modern Ceramic Engineering“, Marcel Decker, New York, 1992 Skript zur Vorlesung

Course L0949: Materials Testing	
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	Dr. Jan Oke Peters
Language	DE
Cycle	WiSe
Content	Application and analysis of basic mechanical as well as non-destructive testing of materials • Determination elastic constants • Tensile test • Fatigue test (testing with constant stress, strain, or plastiv strain amplitude, low and high cycle fatigue, mean stress effect) • Crack growth upon static loading (stress intensity factor, fracture toughness) • Creep test • Hardness test • Charpy impact test • Non destructive testing
Literature	E. Macherauch: Praktikum in Werkstoffkunde, Vieweg G. E. Dieter: Mechanical Metallurgy, McGraw-Hill

Course L0176: Reliability in Engineering Dynamics	
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 min.
Lecturer	Prof. Uwe Weltin
Language	EN
Cycle	SoSe
Content	Method for calculation and testing of reliability of dynamic machine systems • Modeling • System identification • Simulation • Processing of measurement data • Damage accumulation • Test planning and execution
Literature	Bertsche, B.: Reliability in Automotive and Mechanical Engineering. Springer, 2008. ISBN: 978-3-540-33969-4 Inman, Daniel J.: Engineering Vibration. Prentice Hall, 3rd Ed., 2007. ISBN-13: 978-0132281737 Dresig, H., Holzweißig, F.: Maschinendynamik, Springer Verlag, 9. Auflage, 2009. ISBN 3540876936. VDA (Hg.): Zuverlässigkeitssicherung bei Automobilherstellern und Lieferanten. Band 3 Teil 2, 3. überarbeitete Auflage, 2004. ISSN 0943-9412

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

Course L0749: Reliability of Aircraft Systems	
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. Frank Thielecke, Dr. Andreas Vahl, Dr. Uwe Wieczorek
Language	DE
Cycle	WiSe
Content	• Functions of reliability and safety (regulations, certification requirements) • Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment) • Reliability analysis of electrical and mechanical systems
Literature	• CS 25.1309 • SAE ARP 4754 • SAE ARP 4761

Module M1156: Systems Engineering

Courses

Title	Typ	Hrs/wk	CP
Systems Engineering (L1547)	Lecture	3	4
Systems Engineering (L1548)	Recitation Section (large)	1	2

Module Responsible	Prof. Ralf God
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Electrical Engineering • Control Systems Previous knowledge in: • Aircraft Cabin Systems
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to: • understand systems engineering process models, methods and tools for the development of complex Systems • describe innovation processes and the need for technology Management • explain the aircraft development process and the process of type certification for aircraft • explain the system development process, including requirements for systems reliability • identify environmental conditions and test procedures for airborne Equipment • value the methodology of requirements-based engineering (RBE) and model-based requirements engineering (MBRE)
Skills	Students are able to: • plan the process for the development of complex Systems • organize the development phases and development Tasks • assign required business activities and technical Tasks • apply systems engineering methods and tools
Personal Competence	
Social Competence	Students are able to: • understand their responsibilities within a development team and integrate themselves with their role in the overall process
Autonomy	Students are able to: • interact and communicate in a development team which has distributed tasks
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 Minutes
Assignment for the Following Curricula	Aircraft Systems Engineering: Core Qualification: Compulsory International Management and Engineering: Specialisation II. Aviation Systems: Elective Compulsory International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory

Course L1547: Systems Engineering	
Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Ralf God
Language	DE
Cycle	SoSe
Content	The objective of the lecture with the corresponding exercise is to accomplish the prerequisites for the development and integration of complex systems using the example of commercial aircraft and cabin systems. Competences in the systems engineering process, tools and methods is to be achieved. Regulations, guidelines and certification issues will be known. Key aspects of the course are processes for innovation and technology management, system design, system integration and certification as well as tools and methods for systems engineering: • Innovation processes • IP-protection • Technology management • Systems engineering • Aircraft program • Certification issues • Systems development • Safety objectives and fault tolerance • Environmental and operating conditions • Tools for systems engineering • Requirements-based engineering (RBE) • Model-based requirements engineering (MBRE)
Literature	- Skript zur Vorlesung - diverse Normen und Richtlinien (EASA, FAA, RTCA, SAE) - Hauschildt, J., Salomo, S.: Innovationsmanagement. Vahlen, 5. Auflage, 2010 - NASA Systems Engineering Handbook, National Aeronautics and Space Administration, 2007 - Hinsch, M.: Industrielles Luftfahrtmanagement: Technik und Organisation luftfahrttechnischer Betriebe. Springer, 2010 - De Florio, P.: Airworthiness: An Introduction to Aircraft Certification. Elsevier Ltd., 2010 - Pohl, K.: Requirements Engineering. Grundlagen, Prinzipien, Techniken. 2. korrigierte Auflage, dpunkt.Verlag, 2008

Course L1548: Systems Engineering	
Typ	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Ralf God
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1161: Turbomachinery

Courses

Title	Typ	Hrs/wk	CP
Turbomachines (L1562)	Lecture	3	4
Turbomachines (L1563)	Recitation Section (large)	1	2

Module Responsible	Prof. Franz Joos
Admission Requirements	None
Recommended Previous Knowledge	Technical Thermodynamics I, II, Fluid Dynamics, Heat Transfer
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students can • distinguish the physical phenomena of conversion of energy, • understand the different mathematic modelling of turbomachinery, • calculate and evaluate turbomachinery.
Skills	The students are able to - understand the physics of Turbomachinery, - solve excersises self-consistent.
Personal Competence	
Social Competence	The students are able to • discuss in small groups and develop an approach.
Autonomy	The students are able to • develop a complex problem self-consistent, • analyse the results in a critical way, • have an qualified exchange with other students.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Energy Systems: Specialisation Marine Engineering: Elective Compulsory Energy Systems: Specialisation Energy Systems: 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory

Course L1562: Turbomachines

Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Markus Schatz, Prof. Dr. Karsten Meier
Language	DE
Cycle	SoSe
Content	Topics to be covered will include: • Application cases of turbomachinery • Fundamentals of thermodynamics and fluid mechanics • Design fundamentals of turbomachinery • Introduction to the theory of turbine stage • Design and operation of the turbocompressor • Design and operation of the steam turbine • Design and operation of the gas turbine • Physical limits of the turbomachines
Literature	• Traupel: Thermische Turbomaschinen, Springer. Berlin, Heidelberg, New York • Bräunling: Flugzeuggasturbinen, Springer., Berlin, Heidelberg, New York • Seume: Stationäre Gasturbinen, Springer., Berlin, Heidelberg, New York • Menny: Strömungsmaschinen, Teubner., Stuttgart

Course L1563: Turbomachines	
Typ	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Markus Schatz, Prof. Dr. Karsten Meier
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1170: Phenomena and Methods in Materials Science

Courses

Title	Typ	Hrs/wk	CP
Experimental Methods for the Characterization of Materials (L1580)	Lecture	2	3
Phase equilibria and transformations (L1579)	Lecture	2	3

Module Responsible	Prof. Patrick Huber
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge in Materials Science, e.g. Werkstoffwissenschaft I/II
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	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.
Skills	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.
Personal Competence	
Social Competence	The students are able to present solutions to specialists and to develop ideas further.
Autonomy	The students are able to ... • assess their own strengths and weaknesses. • gather new necessary expertise by their own.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	International Management and Engineering: Specialisation II. Product Development and Production: 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 Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Materials Science: Elective Compulsory

Course L1580: Experimental Methods for the Characterization of Materials

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Patrick Huber
Language	DE
Cycle	SoSe
Content	• Structural characterization by photons, neutrons and electrons (in particular X-ray and neutron scattering, electron microscopy, tomography) • Mechanical and thermodynamical characterization methods (indenter measurements, mechanical compression and tension tests, specific heat measurements) • Characterization of optical, electrical and magnetic properties (spectroscopy, electrical conductivity and magnetometry)
Literature	William D. Callister und David G. Rethwisch, Materialwissenschaften und Werkstofftechnik, Wiley&Sons, Asia (2011). William D. Callister, Materials Science and Technology, Wiley& Sons, Inc. (2007).

Course L1579: Phase equilibria and transformations	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Jörg Weißmüller
Language	DE
Cycle	SoSe
Content	Fundamentals of statistical physics, formal structure of phenomenological thermodynamics, simple atomistic models and free-energy functions of solid solutions and compounds. Corrections due to nonlocal interaction (elasticity, gradient terms). Phase equilibria and alloy phase diagrams as consequence thereof. Simple atomistic considerations for interaction energies in metallic solid solutions. Diffusion in real systems. Kinetics of phase transformations for real-life boundary conditions. Partitioning, stability and morphology at solidification fronts. Order of phase transformations; glass transition. Phase transitions in nano- and microscale systems.
Literature	Wird im Rahmen der Lehrveranstaltung bekannt gegeben.

Module M1209: Selected Topics of Product Development, Materials Science and Production (Alternative B: 6 LP)

Courses

Title	Typ	Hrs/wk	CP
Applied Automation (L1592)	Project-/problem-based Learning	3	3
Ergonomics (L0653)	Lecture	2	3
Elements of Integrated Production Systems (L0927)	Project-/problem-based Learning	2	3
Emotional Design / User Centered Product Development (L1703)	Seminar	2	2
Development Management for Mechatronics (L1512)	Lecture	2	3
Fatigue & Damage Tolerance (L0310)	Lecture	2	3
Industry 4.0 for engineers (L2012)	Lecture	2	3
Innovation and Product Management (L2168)	Seminar	2	3
Lightweight Construction with Fibre Reinforced Rolymers - Structural Mechanics (L1514)	Lecture	2	3
Lightweight Design Practical Course (L1258)	Project-/problem-based Learning	3	3
Mechanisms, Systems and Processes of Materials Testing (L0950)	Lecture	2	2
Microsystems Technology (L0724)	Lecture	2	4
Productivity Management (L0928)	Project-/problem-based Learning	2	2
Productivity Management (L0931)	Recitation Section (small)	1	1
Feedback Control in Medical Technology (L0664)	Lecture	2	3
Renewable Energy (L0313)	Lecture	2	2
Renewable Energy (L1434)	Recitation Section (small)	1	1
Six Sigma (L1130)	Lecture	2	3
System Simulation (L1820)	Lecture	2	2
System Simulation (L1821)	Recitation Section (large)	1	2
Technical Design (L1513)	Lecture	2	3
Ceramics Technology (L0379)	Lecture	2	3
Materials Testing (L0949)	Lecture	2	2
Reliability in Engineering Dynamics (L0176)	Lecture	2	2
Reliability in Engineering Dynamics (L1303)	Recitation Section (small)	1	2
Reliability of Aircraft Systems (L0749)	Lecture	2	3

Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous Knowledge	None
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students are able to express their extended knowledge and discuss the connection of different special fields or application areas of product development, materials and production • Students are qualified to connect different special fields with each other
Skills	• Students can apply specialized solution strategies and new scientific methods in selected areas • Students are able to transfer learned skills to new and unknown problems and can develop own solution approaches
Personal Competence	
Social Competence	-
Autonomy	• Students are able to develop their knowledge and skills by autonomous election of courses.
Workload in Hours	Depends on choice of courses
Credit points	6
Assignment for the Following Curricula	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

Course L1592: Applied Automation	
Typ	Project-/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 Minuten
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	-Project Based Learning -Robot Operating System -Robot structure and description -Motion description -Calibration -Accuracy
Literature	John J. Craig Introduction to Robotics – Mechanics and Control ISBN: 0131236296 Pearson Education, Inc., 2005 Stefan Hesse Grundlagen der Handhabungstechnik ISBN: 3446418725 München Hanser, 2010 K. Thulasiraman and M. N. S. Swamy Graphs: Theory and Algorithms ISBN: 9781118033104 John Wüey & Sons, Inc., 1992

Course L0653: Ergonomics	
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	30 Minuten
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	

Course L0927: Elements of Integrated Production Systems	
Typ	Project-/problem-based Learning
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. Hermann Lödding
Language	DE
Cycle	SoSe
Content	not available
Literature	Harris, R.; Harris, C.; Wilson, E.: Making Materials Flow, Lean Enterprise Institute, Cambridge, 2003. Ohno, T.: Das Toyota-Produktionssystem, Campus-Verlag, Frankfurt et al, 1993. Rother, M.: Die Kata des Weltmarktführers. Toyotas Erfolgsmethoden, Campus-Verlag, Frankfurt et al, 2009. Rother, M.; Shook, J.: Sehen lernen: Mit Wertstromdesign die Wertschöpfung erhöhen und Verschwendung beseitigen, Lean Management Institut, Aachen, 2006. Rother, M.; Harris, R.: Creating Continuous Flow, Lean Enterprise Institute, Brookline, 2001. Shingo, S.: A Revolution in Manufacturing. The SMED System, Productivity Press, 2006. Womack, J. P. et al: Die zweite Revolution in der Autoindustrie, Frankfurt/New York, Campus Verlag, 1992.

Course L1703: Emotional Design / User Centered Product Development	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	Teamarbeit und abschließender Vortrag
Lecturer	Jörg Heuser
Language	DE
Cycle	SoSe
Content	Lecture • Objective and subjective perception for the evaluation of product characteristics • Effects of material, color, shape and structure to the acceptance of a product • Aesthetic function of a product • Case studies, lack of acceptance of a product and possible reason Seminar • Identification of non-technical product functions • Identification of subjective influences for the product development Project Work • Topics will be developed in cooperation with the students. Project works will be presented in teams, presented and evaluated Exemplary Project: Holistic product evaluation, product optimization
Literature	Wird in der Veranstaltung angegeben

Course L1512: Development Management for Mechatronics	
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	30 Minuten
Lecturer	Dr. Daniel Steffen
Language	DE
Cycle	SoSe
Content	• Processes and methods of product development - from idea to market launch ◦ identification of market and technology potentials ◦ development of a common product architecture ◦ Synchronized product development across all engineering disciplines ◦ product validation incl. customer view • Steering and optimization of product development ◦ Design of processes for product development ◦ IT systems for product development ◦ Establishment of management standards ◦ Typical types of organization
Literature	• Bender: Embedded Systems - qualitätsorientierte Entwicklung • Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit • Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen • Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung • Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden • Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung • VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme

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. Kluver Academic Puplisher, Dordrecht, 2001 E. Haibach. Betriebsfestigkeit Verfahren und Daten zur Bauteilberechnung. VDI-Verlag, Düsseldorf, 1989

Course L2012: Industry 4.0 for engineers	
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 min
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	
Literature	

Course L2168: Innovation and Product Management	
Typ	Seminar
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	30 min
Lecturer	Dr. Christoph Fuchs
Language	DE
Cycle	SoSe
Content	
Literature	

Course L1514: Lightweight Construction with Fibre Reinforced Rolymers - Structural Mechanics	
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	30 min
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	WiSe
Content	**Fundamentals of Anisotropic Elasticity** Displacements, strains and stresses; Equilibrium equations; Kinematics; Hooke's generalized law **Behaviour of a single laminate layer** Material law of a single laminate layer; Full anisotropy and coupling effects; Material symmetries; Engineering constants; Plane state of stress; Transformation rules **Fundamentals of Micromechanics of a laminate layer** Representative unit cell; Determination of effective material constants; Effective stiffness properties of a single layer **Classical Laminate Plate Theory** Notations and laminate code; Kinematics and displacement field; Strains and stresses, stress resultants; Constitutive equations and coupling effects; Special laminates and their behavior; Effective laminate properties **Strength of Laminated Plates** Fundamental concept; Phenomenological failure criteria: maximum stresses, maximum strains, Tsai-Hill, Tsai-Wu, Puck, Hashin **Bending of Composite Laminated Plates** Differential Equations; Boundary Conditions; Navier-type solutions; Lévy-type solutions **Stress Concentration Problems** Free-edge effects; Stress concentrations at holes, cracks, delaminations; Aspects of failure analysis **Stability of Thin-Walled Composite Structures** Buckling of anisotropic plates and shells; Influence of loading conditions; Influence of boundary conditions; Exact transcendental solutions and their evaluation; Buckling of stiffened composite plates; Minimum stiffness requirements; Local buckling of stiffener profiles **Written exercise (report required)** Assessment of a thin-walled composite laminated beam taking several different dimensioning criteria into account
Literature	• Schürmann, H., „Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage. • Wiedemann, J., „Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage. • Reddy, J.N., „Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al., current edition. • Jones, R.M., „Mechanics of Composite Materials", Scripta Book Co., Washington, current edition. • Timoshenko, S.P., Gere, J.M., „Theory of elastic stability", McGraw-Hill Book Company, Inc., New York, current edition. • Turvey, G.J., Marshall, I.H., „Buckling and postbuckling of composite plates", Chapman and Hall, London, current edition. • Herakovich, C.T., „Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition. • Mittelstedt, C., Becker, W., „Strukturmechanik ebener Laminate", aktuelle Auflage.

Course L1258: Lightweight Design Practical Course	
Typ	Project-/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/EN
Cycle	SoSe
Content	Development of a sandwich structure made of fibre reinforced plastics • getting familiar with fibre reinforced plastics as well as lightweight design • Design of a sandwich structure made of fibre reinforced plastics using finite element analysis (FEA) • Determination of material properties based on sample tests • manufacturing of the structure in the composite lab • Testing of the developed structure • Concept presentation • Self-organised teamwork
Literature	• Schürmann, H., „Konstruieren mit Faser-Kunststoff-Verbunden“, Springer, Berlin, 2005. • Puck, A., „Festigkeitsanalsyse von Faser-Matrix-Laminaten“, Hanser, München, Wien, 1996. • R&G, „Handbuch Faserverbundwerkstoffe“, Waldenbuch, 2009. • VDI 2014 „Entwicklung von Bauteilen aus Faser-Kunststoff-Verbund“ • Ehrenstein, G. W., „Faserverbundkunststoffe“, Hanser, München, 2006. • Klein, B., „Leichtbau-Konstruktion", Vieweg & Sohn, Braunschweig, 1989. • Wiedemann, J., „Leichtbau Band 1: Elemente“, Springer, Berlin, Heidelberg, 1986. • Wiedemann, J., „Leichtbau Band 2: Konstruktion“, Springer, Berlin, Heidelberg, 1986. • Backmann, B.F., „Composite Structures, Design, Safety and Innovation”, Oxford (UK), Elsevier, 2005. • Krause, D., „Leichtbau”, In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012. • Schulte, K., Fiedler, B., „Structure and Properties of Composite Materials”, Hamburg, TUHH - TuTech Innovation GmbH, 2005.

Course L0950: Mechanisms, Systems and Processes of Materials Testing	
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	Dr. Jan Oke Peters
Language	DE
Cycle	SoSe
Content	Application, analysis and discussion of basic and advanced testing methods to ensure correct selection of applicable testing procedure for investigation of part/materials deficiencies • Stress-strain relationships • Strain gauge application • Visko elastic behavior • Tensile test (strain hardening, necking, strain rate) • Compression test, bending test, torsion test • Crack growth upon static loading (J-Integral) • Crack growth upon cyclic loading (micro- und macro cracks) • Effect of notches • Creep testing (physical creep test, influence of stress and temperature, Larson Miller parameter) • Wear testing • Non destructive testing application for overhaul of jet engines
Literature	• E. Macherauch: Praktikum in Werkstoffkunde, Vieweg • G. E. Dieter: Mechanical Metallurgy, McGraw-Hill • R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg • R. Bürgel: Werkstoffe sícher beurteilen und richtig einsetzen, Vieweg

Course L0724: Microsystems Technology	
Typ	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cycle	WiSe
Content	• Introduction (historical view, scientific and economic relevance, scaling laws) • Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution, next-generation lithography, nano-imprinting, molecular imprinting) • Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVD, LPCVD, PECVD and LECVD; screen printing) • Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA, electrochemical etching, anisotropic etching with KOH/TMAH: theory, corner undercutting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering, plasma etching, RIE, Bosch process, cryo process, XeF2 etching) • Surface Micromachining and alternative Techniques (sacrificial etching, film stress, stiction: theory and counter measures; Origami microstructures, Epi-Poly, porous silicon, SOI, SCREAM process, LIGA, SU8, rapid prototyping) • Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensors: thermo resistor, Pt-100, spreading resistance sensor, pn junction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry, IR sensor: thermopile and bolometer) • Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistivity, pressure sensor: piezoresistive, capacitive and fabrication process; accelerometer: piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process) • Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensors: magneto resistance, AMR and GMR, fluxgate magnetometer) • Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; metal oxide semiconductor gas sensor, organic semiconductor gas sensor, Lambda probe, MOSFET gas sensor, pH-FET, SAW sensor, principle of biosensor, Clark electrode, enzyme electrode, DNA chip) • Micro Actuators, Microfluidics and TAS (drives: thermal, electrostatic, piezo electric and electromagnetic; light modulators, DMD, adaptive optics, microscanner, microvalves: passive and active, micropumps, valveless micropump, electrokinetic micropumps, micromixer, filter, inkjet printhead, microdispenser, microfluidic switching elements, microreactor, lab-on-a-chip, microanalytics) • MEMS in medical Engineering (wireless energy and data transmission, smart pill, implantable drug delivery system, stimulators: microelectrodes, cochlear and retinal implant; implantable pressure sensors, intelligent osteosynthesis, implant for spinal cord regeneration) • Design, Simulation, Test (development and design flows, bottom-up approach, top-down approach, testability, modelling: multiphysics, FEM and equivalent circuit simulation; reliability test, physics-of-failure, Arrhenius equation, bath-tub relationship) • System Integration (monolithic and hybrid integration, assembly and packaging, dicing, electrical contact: wire bonding, TAB and flip chip bonding; packages, chip-on-board, wafer-level-package, 3D integration, wafer bonding: anodic bonding and silicon fusion bonding; micro electroplating, 3D-MID)
Literature	M. Madou: Fundamentals of Microfabrication, CRC Press, 2002 N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009 T. M. Adams, R. A. Layton:Introductory MEMS, Springer, 2010 G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008

Course L0928: Productivity Management	
Typ	Project-/problem-based Learning
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. Hermann Lödding
Language	DE
Cycle	SoSe
Content	• Principles of productivity management • Shop floor management and standardisation • Takt analysis and design of manual operations • Maintenance Principles • Total Productive Maintenance (TPM) • Optimisation of set-up operations • Analysis of interlinked production systems
Literature	Bokranz, R.; Landau, K.:Produktivitätsmanagement von Arbeitssystemen. Schäffer-Poeschel, Stuttgart, 2006. Takeda, H.: Das synchrone Produktionssystem: Just-in-Time für das ganze Unternehmen. 5. Aufl., mi-Wirtschaftsbuch, FinanzBuch Verlag, München, 2006. Nakajima, S.: Management der Produktionseinrichtungen (Total Productive Maintenance). Campus Verlag, New York, 1995. Shingo, S.: A Revolution in Manufacturing: The SMED System. Productivity, Inc., 1985

Course L0931: Productivity Management	
Typ	Recitation Section (small)
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. Hermann Lödding
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0664: Feedback Control in Medical Technology	
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	20 min
Lecturer	Johannes Kreuzer, Christian Neuhaus
Language	DE
Cycle	SoSe
Content	Always viewed from the engineer's point of view, the lecture is structured as follows: • Introduction to the topic • Fundamentals of physiological modelling • Introduction to Breathing and Ventilation • Physiology and Pathology in Cardiology • Introduction to the Regulation of Blood Glucose • kidney function and renal replacement therapy • Representation of the control technology on the concrete ventilator • Excursion to a medical technology company Techniques of modeling, simulation and controller development are discussed. In the models, simple equivalent block diagrams for physiological processes are derived and explained how sensors, controllers and actuators are operated. MATLAB and SIMULINK are used as development tools.
Literature	• Leonhardt, S., & Walter, M. (2016). Medizintechnische Systeme. Berlin, Heidelberg: Springer Vieweg. • Werner, J. (2005). Kooperative und autonome Systeme der Medizintechnik. München: Oldenbourg. • Oczenski, W. (2017). Atmen : Atemhilfen ; Atemphysiologie und Beatmungstechnik: Georg Thieme Verlag KG.

Course L0313: Renewable Energy	
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. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	• introduction • solar energy for heat and power generation • wind power for electricity generation • hydropower for electricity generation • ocean energy for electricity generation • geothermal energy for heat and electricty generation
Literature	• Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage • Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg,2007

Course L1434: Renewable Energy	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	60 Minuten
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	Students work on different tasks in the field of renewable energies. They present their solutions in the exercise lesson and discuss it with other students and the lecturer. Possible tasks in the field of renewable energies are: • Solar thermal heat • Concentrating solare power • Photovoltaic • Windenergie • Hydropower • Heat pump • Deep geothermal energy
Literature	• Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage • Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg,2007

Course L1130: Six Sigma	
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. Claus Emmelmann
Language	DE
Cycle	WiSe
Content	• Introduction and structuring • Basic terms of quality management • Measuring and inspection equipment • Tools of quality management: FMEA, QFD, FTA, etc. • Quality management methodology Six Sigma, DMAIC
Literature	Pfeifer, T.: Qualitätsmanagement : Strategien, Methoden, Techniken, 4. Aufl., München 2008 Pfeifer, T.: Praxishandbuch Qualitätsmanagement, München 1996 Geiger, W., Kotte, W.: Handbuch Qualität : Grundlagen und Elemente des Qualitätsmanagements: Systeme, Perspektiven, 5. Aufl., Wiesbaden 2008

Course L1820: System Simulation	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Stefan Wischhusen
Language	DE
Cycle	WiSe
Content	All participants must bring a notebook, to install and use the software OpenModelica. • Instruction and modelling of physical processes • Modelling and limits of model • Time constant, stiffness, stability, step size • Terms of object orientated programming • Differential equations of simple systems • Introduction into Modelica • Introduction into simulation tool • Example: Heat transfer • Example: System with different subsystems
Literature	[1] Modelica Association: "Modelica Language Specification - Version 3.3", Linköping, Sweden, 2 0 1 2 [2] M. Tiller: "Modelica by Example", http://book.xogeny.com, 2014. [3] M. Otter, H. Elmqvist, et al.: "Objektorientierte Modellierung Physikalischer Systeme", at- Automatisierungstechnik (german), Teil 1 - 17, Oldenbourg Verlag, 1999 - 2000. [4] P. Fritzson: "Principles of Object-Oriented Modeling and Simulation with Modelica 3.3", Wiley-IEEE Press, New York, 2015. [5] P. Fritzson: "Introduction to Modeling and Simulation of Technical and Physical Systems with Modelica", Wiley, New York, 2011.

Course L1821: System Simulation	
Typ	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Stefan Wischhusen
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1513: Technical Design	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	10-15 Entwurfszeichnungen, Skizzen und ca. 5-10 A4-Dokumentationsseiten (Themen- und Entwurfsbegründung)
Lecturer	Prof. Werner Granzeier
Language	DE
Cycle	SoSe
Content	• Basics with analysis, concept, proposal drawings and sketches • Samples from practice of technical industrial design • Product concept with new ideas and package • ID proposal with structural concept and external product ergonomics • Visualisation and presentation of the overall concept • Realization as individual case studies
Literature	Literatur über technisches Produktdesign Technisches Rendering und Präsentation

Zeichnen und perspektivisches Entwerfen

Literaturhinweise

What is Product Design ?

Laura Slack

RotoVision Schweiz 2006

Product Design Now

Design and Scetches

CollinsDesign and maomao publications Spanien 2006

Ronald B. Kemnitzer, Rendering With Markers - Definitive Techniques

for Designers, Illustrators and Architects,

Watson, Guptil Puplications,a division of Billboard Publications Inc.,

New York 1983

Creative Techniques

DRAWING

Barons Educational Series

ISBN-13: 978-0-7641-6182-7

Joseph Ungar, Rendering In Mixed Media - Techniques for Concept

Presentation for Designers and Illustrators

Watson-Guptil Publication a division of Billboard Publications Inc.,

New York 1985

AIRWORLD

Design und Architektur für die Flugreise

Vitra Design Stiftung   Weil am Rhein 2004

Airline Design

Perter Deslius Jacek Slaski te Neues 2005

Technik und Sicherheit von Passagierflugzeugen

Frank Littek

Motorbuch Verlag 2003

Jetliner Cabins

Jennifer Coutts Clay

Cs books   England 2006

BOEING Widebodies

Michael Haenggi   motorbooks international USA 2003

form - Zeitschrift für Gestaltung, Verlag form GmbH,

Hofgut Ober-Berrbach, 6104 Seeheim-Jugenheim

(erscheint vierteljährlich, Verlag form GmbH)

design report

german magasin,

(erscheint monatlich)

md - möbel interior design, Konradin-Verlag

Robert Kohlhammer GmbH, 7022 Leinfelden-Echterdingen

(erscheint monatlich)

CAR STYLING, Car Styling Publishing Co. 4-8-16-11F,

Kitashinjuku, Shinjuku-ku, Tokio 160, Japan

(erscheint vierteljährlich in japanischer und englischer Sprache, in Hamburg erhältlich bei: Overseas Courier Service Deutschland GmbH,

Auto & Design,

Corso Frabcia 161, 10139 Torino, Italia

	(erscheint vierteljährlich in italienischer und englischer Sprache alle zwei Monate , erhältlich am HBF Hamburg AERO International, Magazin für Zivilluftfahrt (erscheint monatlich) Aircraft interior international Engl. magasin for Aircraft cabin interior (erscheint 2 monatlich) aerotec Technik- und Branchenmagazin für die Luft- und Raumfahrtindustrie

Course L0379: Ceramics Technology	
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	Dr. Rolf Janßen
Language	DE/EN
Cycle	WiSe
Content	Introduction to ceramic processing with emphasis on advanced structural ceramics. The course focus predominatly on powder-based processing, e.g. “powder-metauurgical techniques and sintering (soild state and liquid phase). Also, some aspects of glass and cement science as well as new developments in powderless forming techniques of ceramics and ceramic composites will be addressed Examples will be discussed in order to give engineering students an understanding of technology development and specific applications of ceramic components. **Content:** 1. Introduction Inhalt: 2. Raw materials 3. Powder fabrication 4. Powder processing 5. Shape-forming processes 6. Densification, sintering 7. Glass and Cement technology 8. Ceramic-metal joining techniques
Literature	W.D. Kingery, „Introduction to Ceramics“, John Wiley & Sons, New York, 1975 ASM Engineering Materials Handbook Vol.4 „Ceramics and Glasses“, 1991 D.W. Richerson, „Modern Ceramic Engineering“, Marcel Decker, New York, 1992 Skript zur Vorlesung

Course L0949: Materials Testing	
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	Dr. Jan Oke Peters
Language	DE
Cycle	WiSe
Content	Application and analysis of basic mechanical as well as non-destructive testing of materials • Determination elastic constants • Tensile test • Fatigue test (testing with constant stress, strain, or plastiv strain amplitude, low and high cycle fatigue, mean stress effect) • Crack growth upon static loading (stress intensity factor, fracture toughness) • Creep test • Hardness test • Charpy impact test • Non destructive testing
Literature	E. Macherauch: Praktikum in Werkstoffkunde, Vieweg G. E. Dieter: Mechanical Metallurgy, McGraw-Hill

Course L0176: Reliability in Engineering Dynamics	
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 min.
Lecturer	Prof. Uwe Weltin
Language	EN
Cycle	SoSe
Content	Method for calculation and testing of reliability of dynamic machine systems • Modeling • System identification • Simulation • Processing of measurement data • Damage accumulation • Test planning and execution
Literature	Bertsche, B.: Reliability in Automotive and Mechanical Engineering. Springer, 2008. ISBN: 978-3-540-33969-4 Inman, Daniel J.: Engineering Vibration. Prentice Hall, 3rd Ed., 2007. ISBN-13: 978-0132281737 Dresig, H., Holzweißig, F.: Maschinendynamik, Springer Verlag, 9. Auflage, 2009. ISBN 3540876936. VDA (Hg.): Zuverlässigkeitssicherung bei Automobilherstellern und Lieferanten. Band 3 Teil 2, 3. überarbeitete Auflage, 2004. ISSN 0943-9412

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

Course L0749: Reliability of Aircraft Systems	
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. Frank Thielecke, Dr. Andreas Vahl, Dr. Uwe Wieczorek
Language	DE
Cycle	WiSe
Content	• Functions of reliability and safety (regulations, certification requirements) • Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment) • Reliability analysis of electrical and mechanical systems
Literature	• CS 25.1309 • SAE ARP 4754 • SAE ARP 4761

Module M1226: Mechanical Properties

Courses

Title	Typ	Hrs/wk	CP
Mechanical Behaviour of Brittle Materials (L1661)	Lecture	2	3
Dislocation Theory of Plasticity (L1662)	Lecture	2	3

Module Responsible	Dr. Erica Lilleodden
Admission Requirements	None
Recommended Previous Knowledge	Basics in Materials Science I/II
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can explain basic principles of crystallography, statics (free body diagrams, tractions) and thermodynamics (energy minimization, energy barriers, entropy)
Skills	Students are capable of using standardized calculation methods: tensor calculations, derivatives, integrals, tensor transformations
Personal Competence	
Social Competence	Students can provide appropriate feedback and handle feedback on their own performance constructively.
Autonomy	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
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Materials Science: Core Qualification: Compulsory Mechanical Engineering and Management: Specialisation Materials: 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: Compulsory Theoretical Mechanical Engineering: Specialisation Materials Science: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

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

Course L1662: Dislocation Theory of Plasticity	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Erica Lilleodden
Language	DE/EN
Cycle	SoSe
Content	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. 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.
Literature	Vorlesungsskript Aktuelle Publikationen Bücher: Introduction to Dislocations, by D. Hull and D.J. Bacon Theory of Dislocations, by J.P. Hirth and J. Lothe Physical Metallurgy, by Peter Hassen

Module M0840: Optimal and Robust Control

Courses

Title	Typ	Hrs/wk	CP
Optimal and Robust Control (L0658)	Lecture	2	3
Optimal and Robust Control (L0659)	Recitation Section (small)	2	3

Module Responsible	Prof. Herbert Werner
Admission Requirements	None
Recommended Previous Knowledge	• Classical control (frequency response, root locus) • State space methods • Linear algebra, singular value decomposition
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students can explain the significance of the matrix Riccati equation for the solution of LQ problems. • They can explain the duality between optimal state feedback and optimal state estimation. • They can explain how the H2 and H-infinity norms are used to represent stability and performance constraints. • They can explain how an LQG design problem can be formulated as special case of an H2 design problem. • They can explain how model uncertainty can be represented in a way that lends itself to robust controller design • They can explain how - based on the small gain theorem - a robust controller can guarantee stability and performance for an uncertain plant. • They understand how analysis and synthesis conditions on feedback loops can be represented as linear matrix inequalities.
Skills	• Students are capable of designing and tuning LQG controllers for multivariable plant models. • They are capable of representing a H2 or H-infinity design problem in the form of a generalized plant, and of using standard software tools for solving it. • They are capable of translating time and frequency domain specifications for control loops into constraints on closed-loop sensitivity functions, and of carrying out a mixed-sensitivity design. • They are capable of constructing an LFT uncertainty model for an uncertain system, and of designing a mixed-objective robust controller. • They are capable of formulating analysis and synthesis conditions as linear matrix inequalities (LMI), and of using standard LMI-solvers for solving them. • They can carry out all of the above using standard software tools (Matlab robust control toolbox).
Personal Competence	
Social Competence	Students can work in small groups on specific problems to arrive at joint solutions.
Autonomy	Students are able to find required information in sources provided (lecture notes, literature, software documentation) and use it to solve given problems.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Oral exam
Examination duration and scale	30 min
Assignment for the Following Curricula	Computer Science: Specialisation Intelligence Engineering: Elective Compulsory Electrical Engineering: Specialisation Control and Power Systems Engineering: Elective Compulsory Energy Systems: Core Qualification: Elective Compulsory Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory Mechatronics: Specialisation System Design: 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 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Core Qualification: Elective Compulsory

Course L0658: Optimal and Robust Control	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	EN
Cycle	SoSe
Content	• Optimal regulator problem with finite time horizon, Riccati differential equation • Time-varying and steady state solutions, algebraic Riccati equation, Hamiltonian system • Kalman’s identity, phase margin of LQR controllers, spectral factorization • Optimal state estimation, Kalman filter, LQG control • Generalized plant, review of LQG control • Signal and system norms, computing H2 and H∞ norms • Singular value plots, input and output directions • Mixed sensitivity design, H∞ loop shaping, choice of weighting filters • Case study: design example flight control • Linear matrix inequalities, design specifications as LMI constraints (H2, H∞ and pole region) • Controller synthesis by solving LMI problems, multi-objective design • Robust control of uncertain systems, small gain theorem, representation of parameter uncertainty
Literature	• Werner, H., Lecture Notes: "Optimale und Robuste Regelung" • Boyd, S., L. El Ghaoui, E. Feron and V. Balakrishnan "Linear Matrix Inequalities in Systems and Control", SIAM, Philadelphia, PA, 1994 • Skogestad, S. and I. Postlewhaite "Multivariable Feedback Control", John Wiley, Chichester, England, 1996 • Strang, G. "Linear Algebra and its Applications", Harcourt Brace Jovanovic, Orlando, FA, 1988 • Zhou, K. and J. Doyle "Essentials of Robust Control", Prentice Hall International, Upper Saddle River, NJ, 1998

Course L0659: Optimal and Robust Control	
Typ	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1343: Fibre-polymer-composites

Courses			
Title	**Typ**	**Hrs/wk**	**CP**
Structure and properties of fibre-polymer-composites (L1894)	Lecture	2	3
Design with fibre-polymer-composites (L1893)	Lecture	2	3

Module Responsible	Prof. Bodo Fiedler
Admission Requirements	None
Recommended Previous Knowledge	Basics: chemistry / physics / materials science
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can use the knowledge of fiber-reinforced composites (FRP) and its constituents to play (fiber / matrix) and define the necessary testing and analysis. They can explain the complex relationships structure-property relationship and the interactions of chemical structure of the polymers, their processing with the different fiber types, including to explain neighboring contexts (e.g. sustainability, environmental protection).
Skills	Students are capable of • using standardized calculation methods in a given context to mechanical properties (modulus, strength) to calculate and evaluate the different materials. • approximate sizing using the network theory of the structural elements implement and evaluate. • selecting appropriate solutions for mechanical recycling problems and sizing example stiffness, corrosion resistance.
Personal Competence	
Social Competence	Students can • arrive at funded work results in heterogenius groups and document them. • provide appropriate feedback and handle feedback on their own performance constructively.
Autonomy	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. - assess possible consequences of their professional activity.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	180 min
Assignment for the Following Curricula	Energy Systems: Core Qualification: Elective Compulsory Aircraft Systems Engineering: Specialisation Cabin Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Air Transportation Systems: Elective Compulsory International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Materials Science: Specialisation Engineering Materials: Elective Compulsory Mechanical Engineering and Management: 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 Renewable Energies: Specialisation Bioenergy Systems: Elective Compulsory Renewable Energies: Specialisation Wind Energy Systems: Elective Compulsory Renewable Energies: Specialisation Solar Energy Systems: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Materials Science: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

Course L1894: Structure and properties of fibre-polymer-composites	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler
Language	EN
Cycle	SoSe
Content	- Microstructure and properties of the matrix and reinforcing materials and their interaction - Development of composite materials - Mechanical and physical properties - Mechanics of Composite Materials - Laminate theory - Test methods - Non destructive testing - Failure mechanisms - Theoretical models for the prediction of properties - Application
Literature	Hall, Clyne: Introduction to Composite materials, Cambridge University Press Daniel, Ishai: Engineering Mechanics of Composites Materials, Oxford University Press Mallick: Fibre-Reinforced Composites, Marcel Deckker, New York

Course L1893: Design with fibre-polymer-composites	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler
Language	EN
Cycle	SoSe
Content	Designing with Composites: Laminate Theory; Failure Criteria; Design of Pipes and Shafts; Sandwich Structures; Notches; Joining Techniques; Compression Loading; Examples
Literature	Konstruieren mit Kunststoffen, Gunter Erhard , Hanser Verlag

Module M1344: Processing of fibre-polymer-composites

Courses

Title	Typ	Hrs/wk	CP
Processing of fibre-polymer-composites (L1895)	Lecture	2	3
From Molecule to Composites Part (L1516)	Project-/problem-based Learning	2	3

Module Responsible	Prof. Bodo Fiedler
Admission Requirements	None
Recommended Previous Knowledge	Knowledge in the basics of chemistry / physics / materials science
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to give a summary of the technical details of the manufacturing processes composites and illustrate respective relationships. They are capable of describing and communicating relevant problems and questions using appropriate technical language. They can explain the typical process of solving practical problems and present related results.
Skills	Students can use the knowledge of fiber-reinforced composites (FRP) and its constituents (fiber / matrix) and define the necessary testing and analysis. They can explain the complex structure-property relationship and the interactions of chemical structure of the polymers, their processing with the different fiber types, including to explain neighboring contexts (e.g. sustainability, environmental protection).
Personal Competence	
Social Competence	Students are able to cooperate in small, mixed-subject groups in order to independently derive solutions to given problems in the context of civil engineering. They are able to effectively present and explain their results alone or in groups in front of a qualified audience. Students have the ability to develop alternative approaches to an engineering problem independently or in groups and discuss advantages as well as drawbacks.
Autonomy	Students are capable of independently solving mechanical engineering problems using provided literature. They are able to fill gaps in as well as extent their knowledge using the literature and other sources provided by the supervisor. Furthermore, they can meaningfully extend given problems and pragmatically solve them by means of corresponding solutions and concepts.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Materials Science: Specialisation Engineering Materials: Elective Compulsory Mechanical Engineering and Management: Specialisation Materials: 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

Course L1895: Processing of fibre-polymer-composites

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler
Language	DE/EN
Cycle	SoSe
Content	Manufacturing of Composites: Hand Lay-Up; Pre-Preg; GMT, BMC; SMC, RIM; Pultrusion; Filament Winding
Literature	Åström: Manufacturing of Polymer Composites, Chapman and Hall

Course L1516: From Molecule to Composites Part	
Typ	Project-/problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler
Language	DE/EN
Cycle	SoSe
Content	Students get the task in the form of a customer request for the development and production of a MTB handlebar made of fiber composites. In the task technical and normative requirements (standards) are given, all other required information come from the lectures and tutorials, and the respective documents (electronically and in conversation). The procedure is to specify in a milestone schedule and allows students to plan tasks and to work continuously. At project end, each group has a made handlebar with approved quality. In each project meeting the design (discussion of the requirements and risks) are discussed. The calculations are analyzed, evaluated and established manufacturing methods are selected. Materials are selected bar will be produced. The quality and the mechanical properties are checked. At the end of the final report created (compilation of the results for the "customers"). After the test during the "customer / supplier conversation" there is a mutual feedback-talk ("lessons learned") in order to ensure the continuous improvement.
Literature	Customer Request ("Handout")

Module M1174: Automation Technology and Systems

Courses

Title	Typ	Hrs/wk	CP
Automation Technology and Systems (L2329)	Lecture	4	4
Automation Technology and Systems (L2331)	Project-/problem-based Learning	1	1
Automation Technology and Systems (L2330)	Recitation Section (small)	1	1

Module Responsible	Prof. Thorsten Schüppstuhl
Admission Requirements	None
Recommended Previous Knowledge	without major course assessment
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students • know the characteristic components of an automation systems and have good understanding of their interaction • know methods for a systematical analysis of automation tasks and are able to use them • have special competences in industrial robot based automation systems
Skills	Students are able to... • analyze complex Automation tasks • develop application based concepts and solutions • design subsystems and integrate into one system • investigate and evaluate safety of machinery • create simple programs for robots and programmable logic controllers • design of circuit for pneumatic applications
Personal Competence	
Social Competence	Students are able to ... - find solutions for automation and handling tasks in groups - develop solutions in a production environment with qualified personnel at technical level and represent decisions.
Autonomy	Students are able to ... • analyze automation tasks independently • generate programs for robots and programmable logic devices autonomously • develop solutions for practice oriented tasks of automation independently • design safety concepts for automation applications • assess consequences of their professional actions and responsibilities
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Production: Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory

Course L2329: Automation Technology and Systems

Typ	Lecture
Hrs/wk	4
CP	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	
Literature	

Course L2331: Automation Technology and Systems	
Typ	Project-/problem-based Learning
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L2330: Automation Technology and Systems	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0563: Robotics

Courses			
Title	**Typ**	**Hrs/wk**	**CP**
Robotics: Modelling and Control (L0168)	Lecture	3	3
Robotics: Modelling and Control (L1305)	Recitation Section (large)	2	3

Module Responsible	Prof. Uwe Weltin
Admission Requirements	None
Recommended Previous Knowledge	Fundamentals of electrical engineering Broad knowledge of mechanics Fundamentals of control theory
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to describe fundamental properties of robots and solution approaches for multiple problems in robotics.
Skills	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.
Personal Competence	
Social Competence	Students are able to work goal-oriented in small mixed groups.
Autonomy	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.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	Aircraft Systems Engineering: Specialisation Aircraft Systems: 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Robotics and Computer Science: Elective Compulsory

Course L0168: Robotics: Modelling and Control

Typ	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Dr. Martin Gomse, Prof. Uwe Weltin
Language	EN
Cycle	WiSe
Content	Fundamental kinematics of rigid body systems Newton-Euler equations for manipulators Trajectory generation Linear and nonlinear control of robots
Literature	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	
Typ	Recitation Section (large)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Martin Gomse, Prof. Uwe Weltin
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0771: Flight Physics

Courses

Title	Typ	Hrs/wk	CP
Aerodynamics and Flight Mechanics I (L0727)	Lecture	3	3
Flight Mechanics II (L0730)	Lecture	2	2
Flight Mechanics II (L0731)	Recitation Section (large)	1	1

Module Responsible	Prof. Frank Thielecke
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Aviation
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	
Skills	
Personal Competence	
Social Competence	
Autonomy	
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 Minutes (WS) + 90 Minutes (SS)
Assignment for the Following Curricula	Aircraft Systems Engineering: Core Qualification: Compulsory International Management and Engineering: Specialisation II. Aviation Systems: 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 Aircraft Systems Engineering: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

Course L0727: Aerodynamics and Flight Mechanics I

Typ	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Frank Thielecke, Dr. Ralf Heinrich, Mike Montel
Language	DE
Cycle	WiSe
Content	• Aerodynamics (fundamental equations of aerodynamics; compressible and incompressible flows; airfoils and wings; viscous flows) • Flight Mechanics (Equations of motion; flight performance; control surfaces; derivatives; lateral stability and control; trim conditions; flight maneuvers)
Literature	• Schlichting, H.; Truckenbrodt, E.: Aerodynamik des Flugzeuges I und II • Etkin, B.: Dynamics of Atmospheric Flight • Sachs/Hafer: Flugmechanik • Brockhaus: Flugregelung • J.D. Anderson: Introduction to flight

Course L0730: Flight Mechanics II	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Frank Thielecke, Mike Montel
Language	DE
Cycle	SoSe
Content	• stationary asymmetric flight • dynamics of lateral movement • methods of flight simulation • eyperimental methods of flight mechanics • model validation using system identification • wind tunnel techniques
Literature	• Schlichting, H.; Truckenbrodt, E.: Aerodynamik des Flugzeuges I und II • Etkin, B.: Dynamics of Atmospheric Flight • Sachs/Hafer: Flugmechanik • Brockhaus: Flugregelung • J.D. Anderson: Introduction to flight

Course L0731: Flight Mechanics II	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Frank Thielecke, Mike Montel
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0815: Product Planning

Courses			
Title	**Typ**	**Hrs/wk**	**CP**
Product Planning (L0851)	Project-/problem-based Learning	3	3
Product Planning Seminar (L0853)	Project-/problem-based Learning	2	3

Module Responsible	Prof. Cornelius Herstatt
Admission Requirements	None
Recommended Previous Knowledge	Good basic-knowledge of Business Administration
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	

Knowledge	Students will gain insights into:
	• Product Planning
	  ◦ Process
	  ◦ Methods
	• Design thinking
	  ◦ Process
	  ◦ Methods
	  ◦ User integration

Skills	Students will gain deep insights into:
	• Product Planning
	  ◦ Process-related aspects
	  ◦ Organisational-related aspects
	  ◦ Human-Ressource related aspects
	  ◦ Working-tools, methods and instruments
	  ◦

Personal Competence	
Social Competence	• Interact within a team • Raise awareness for globabl issues
Autonomy	• Gain access to knowledge sources • Interpret complex cases • Develop presentation skills
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	**Compulsory** Yes, **Bonus** 20 %, **Form** Subject theoretical and practical work, **Description**
Examination	Written exam
Examination duration and scale	90 minutes
Assignment for the Following Curricula	Global Innovation Management: Core Qualification: Compulsory International Management and Engineering: Specialisation I. Electives Management: Elective Compulsory Mechanical Engineering and Management: Specialisation 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 Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

Course L0851: Product Planning	
Typ	Project-/problem-based Learning
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Cornelius Herstatt
Language	EN
Cycle	WiSe
Content	Product Planning Process 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.: • Systematic scanning of markets for innovation opportunities • Understanding strengths/weakness and specific core competences of a firm as platforms for innovation • Exploring relevant sources for innovation (customers, suppliers, Lead Users, etc.) • Developing ideas for radical innovation, relying on the creativeness of employees, using techniques to stimulate creativity and creating a stimulating environment • Transferring ideas for innovation into feasible concepts which have a high market attractively Voluntary presentations in the third hour (articles / case studies) - Guest lectures by researchers - Lecture on Sustainability with frequent reference to current research - Permanent reference to current research Examination: In addition to the written exam at the end of the module, students have to attend the PBL-exercises and prepare presentations in groups in order to pass the module. Additionally, students have the opportunity to present research papers on a voluntary base. With these presentations it is possible to gain a bonus of max. 20% for the exam. However, the bonus is only valid if the exam is passed without the bonus.
Literature	Ulrich, K./Eppinger, S.: Product Design and Development, 2nd. Edition, McGraw-Hill 2010

Course L0853: Product Planning Seminar	
Typ	Project-/problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Cornelius Herstatt
Language	EN
Cycle	WiSe
Content	Seminar is integrative part of the Module Product Planning (for content see lecture) and can not be choosen independantly.
Literature	See lecture information "Product Planning".

Module M0830: Environmental Protection and Management

Courses			
Title	**Typ**	**Hrs/wk**	**CP**
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

Module Responsible	Prof. Ralf Otterpohl
Admission Requirements	None
Recommended Previous Knowledge	• Good knowledge in Technologies for Environmental Protection (end-of-pipe, integrated solutions) • Good knowledge of the relevant Environmental Legislation • Basic knowledge of instruments for Environmental Assessment
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	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.
Skills	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.
Personal Competence	
Social Competence	The students can work together in international groups.
Autonomy	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.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Bioprocess Engineering: Specialisation C - Bioeconomic Process Engineering, Focus Management and Controlling: Elective Compulsory Energy and Environmental Engineering: Specialisation Environmental Engineering: Elective Compulsory Environmental Engineering: Core Qualification: 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	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	WiSe
Content	The lecture focusses on: • The Regulatory Framework • Pollution & Impacts, Characteristics of Pollutants • Approaches of Integrated Pollution Control • Sevilla Process, Best Available Technologies & BREF Documents • Case Studies: paper industry, cement industry, automotive industry • Field Trip
Literature	**Förstner**, Ulrich (1998): Integrated Pollution Control, Springer-Verlag Berlin Heidelberg, ISBN 978-3-642-80313-0 **Shen**, Thomas T. (1999): Industrial Pollution Prevention, Springer-Verlag Berlin Heidelberg, ISBN 978-3-540-65208-3

Course L0387: Health, Safety and Environmental Management	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Hans-Joachim Nau
Language	EN
Cycle	WiSe
Content	• 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
Literature	C. Stephan: Industrial Health, Safety and Environmental Management, MV-Verlag, Münster, 2007/2012 (can be found in the library under GTG 315) Exercises can be downloaded from StudIP

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

Module M0962: Sustainability and Risk Management

Courses			
Title	**Typ**	**Hrs/wk**	**CP**
Safety, Reliability and Risk Assessment (L1145)	Seminar	2	3
Environment and Sustainability (L0319)	Lecture	2	3

Module Responsible	Prof. Kerstin Kuchta
Admission Requirements	None
Recommended Previous Knowledge	none
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to describe single techniques and to give an overview for the field of safety and risk assessment as well as environmental and sustainable engineering, in detail: • basics in safety and reliability of technical facilities • safety and reliability analysis methods • risk assessment • Production and usage of bio-char • energy production and supply • sustainable product design
Skills	Students are able apply interdisciplinary system-oriented methods for risk assessment and sustainability reporting. They can evaluate the effort and costs for processes and select economically feasible treatment concepts.
Personal Competence	
Social Competence	
Autonomy	Students can gain knowledge of the subject area from given sources and transform it to new questions. Furthermore, they can define targets for new application or research-oriented duties in for risk management and sustainability concepts accordance with the potential social, economic and cultural impact.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and scale	Elaboration and presentation (45 minutes in groups)
Assignment for the Following Curricula	Civil Engineering: Core Qualification: Compulsory Bioprocess Engineering: Specialisation C - Bioeconomic Process Engineering, Focus Management and Controlling: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: 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: Core Qualification: Compulsory

Course L1145: Safety, Reliability and Risk Assessment	
Typ	Seminar
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Marco Ritzkowski
Language	DE
Cycle	WiSe
Content	An introduction in safety and risk assessment is given and some typical problems of structural and environmental engineering are treated: • basics in safety and reliability of technical facilities • safety and reliability analysis methods • risk assessment • practical examples and excursions • discussions and presentations
Literature	- Vorlesungsunterlagen - Schneider, J., Schlatter, H.P.: Sicherheit und Zuverlässigkeit im Bauwesen. www.risksafety.ch/files/**sicherheit**_und_zuverlaessigkeit.pdf

Course L0319: Environment and Sustainability	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Kerstin Kuchta
Language	EN
Cycle	WiSe
Content	This course presents actual methodologies and examples of environmental relevant, sustainable technologies, concepts and strategies in the field of energy supply, product design, water supply, waste water treatment or mobility. The following list show examples. Production and Usage of Bio-char Engergy production with algae Environmental product design Clean Development mechanism (CDM) Democracy and Energy New Concepts for a sustainable Energy Supply Recycling of Wind Turbines Alternative Mobility Disposal of Nuclear Wastes Waste2Energy Offshore Wind energy
Literature	Wird in der Veranstaltung bekannt gegeben.

Module M1024: Methods of Integrated Product Development

Courses

Title	Typ	Hrs/wk	CP
Integrated Product Development II (L1254)	Lecture	3	3
Integrated Product Development II (L1255)	Project-/problem-based Learning	2	3

Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge of Integrated product development and applying CAE systems
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	After passing the module students are able to: • explain technical terms of design methodology, • describe essential elements of construction management, • describe current problems and the current state of research of integrated product development.
Skills	After passing the module students are able to: • select and apply proper construction methods for non-standardized solutions of problems as well as adapt new boundary conditions, • solve product development problems with the assistance of a workshop based approach, • choose and execute appropriate moderation techniques.
Personal Competence	
Social Competence	After passing the module students are able to: • prepare and lead team meetings and moderation processes, • work in teams on complex tasks, • represent problems and solutions and advance ideas.
Autonomy	After passing the module students are able to: • give a structured feedback and accept a critical feedback, • implement the accepted feedback autonomous.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Oral exam
Examination duration and scale	30 Minuten
Assignment for the Following Curricula	Aircraft Systems Engineering: Specialisation Cabin Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Air Transportation Systems: Elective Compulsory International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory

Course L1254: Integrated Product Development II	
Typ	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	**Lecture** The lecture extends and enhances the learned content of the module “Integrated Product Development and lightweight design” and is based on the knowledge and skills acquired there. Topics of the course include in particular: • Methods of product development, • Presentation techniques, • Industrial Design, • Design for variety • Modularization methods, • Design catalogs, • Adapted QFD matrix, • Systematic material selection, • Assembly oriented design, Construction management • CE mark, declaration of conformity including risk assessment, • Patents, patent rights, patent monitoring • Project management (cost, time, quality) and escalation principles, • Development management for mechatronics, • Technical Supply Chain Management. **Exercise (PBL)** In the exercise the content presented in the lecture “Integrated Product Development II” and methods of product development and design management will be enhanced. Students learn an independently moderated and workshop based approach through industry related practice examples to solve complex and currently existing issues in product development. They will learn the ability to apply important methods of product development and design management autonomous and acquire further expertise in the field of integrated product development. Besides personal skills, such as teamwork, guiding discussions and representing work results will be acquired through the workshop based structure of the event under its own planning and management.
Literature	• Andreasen, M.M., Design for Assembly, Berlin, Springer 1985. • Ashby, M. F.: Materials Selection in Mechanical Design, München, Spektrum 2007. • Beckmann, H.: Supply Chain Management, Berlin, Springer 2004. • Hartmann, M., Rieger, M., Funk, R., Rath, U.: Zielgerichtet moderieren. Ein Handbuch für Führungskräfte, Berater und Trainer, Weinheim, Beltz 2007. • Pahl, G., Beitz, W.: Konstruktionslehre, Berlin, Springer 2006. • Roth, K.H.: Konstruieren mit Konstruktionskatalogen, Band 1-3, Berlin, Springer 2000. • Simpson, T.W., Siddique, Z., Jiao, R.J.: Product Platform and Product Family Design. Methods and Applications, New York, Springer 2013.

Course L1255: Integrated Product Development II	
Typ	Project-/problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1025: Fluidics

Courses

Title	Typ	Hrs/wk	CP
Fluidics (L1256)	Lecture	2	3
Fluidics (L1371)	Project-/problem-based Learning	1	2
Fluidics (L1257)	Recitation Section (large)	1	1

Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous Knowledge	Good knowledge of mechanics (stereo statics, elastostatics, hydrostatics, kinematics and kinetics), fluid mechanics, and engineering design
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	After passing the module students are able to • explain structures and functionalities of hydrostatic, pneumatic, and hydrodynamic components, • explain the interaction of hydraulic components in hydraulic systems, • explain open and closed loop control of hydraulic systems, • describe functioning and applications of hydrodynamic torque converters, brakes and clutches as well as centrifugal pumps and aggregates in plant technology
Skills	After passing the module students are able to • analyse and assess hydraulic and pneumatic components and systems, • design and dimension hydraulic systems for mechanical applications, • perform numerical simulations of hydraulic systems based on abstract problem definitions, • select and adapt pump characteristic curves for hydraulic systems • dimension hydrodynamic torque converters and brakes for mechanical aggregates.
Personal Competence	
Social Competence	After passing the module students are able to • discuss and present functional context in groups, • organise teamwork autonomously.
Autonomy	After passing the module students are able to • obtain necessary knowledge for the simulation.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	**Compulsory**: Yes; **Bonus**: None; **Form**: Attestation; **Description**: Simulation hydrostatischer Systeme
Examination	Written exam
Examination duration and scale	90
Assignment for the Following Curricula	International Management and Engineering: Specialisation II. Mechatronics: Elective Compulsory International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory

Course L1256: Fluidics	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	**Lecture** Hydrostatics • physical fundamentals • hydraulic fluids • hydrostatic machines • valves • components • hydrostatic transmissions • examples from industry Pneumatics • generation of compressed air • pneumatic motors • Examples of use Hydrodynamics • physical fundamentals • hydraulic continous-flow machines • hydrodynamic transmissions • interoperation of motor and transmission **Exercise** Hydrostatics • reading and design of hydraulic diagrams • dimensioning of hydrostatic traction and working drives • performance calculation Hydrodynamics • calculation / dimensioning of hydrodynamic torque converters • calculation / dimensioning of centrifugal pumps • creating and reading of characteristic curves of pumps and systems Field trip • field trip to a regional company from the hydraulic industry. **Exercise** Numerical simulation of hydrostatic systems • getting to know a numerical simulation environment for hydraulic systems • transformation of a task into a simulation model • simulation of common components • variation of simulation parameters • using simulations for system dimensioning and optimisation • (partly) self-organised teamwork
Literature	Bücher • Murrenhoff, H.: Grundlagen der Fluidtechnik - Teil 1: Hydraulik, Shaker Verlag, Aachen, 2011 • Murrenhoff, H.: Grundlagen der Fluidtechnik - Teil 2: Pneumatik, Shaker Verlag, Aachen, 2006 • Matthies, H.J. Renius, K.Th.: Einführung in die Ölhydraulik, Teubner Verlag, 2006 • Beitz, W., Grote, K.-H.: Dubbel - Taschenbuch für den Maschinenbau, Springer-Verlag, Berlin, aktuelle Auflage Skript zur Vorlesung

Course L1371: Fluidics	
Typ	Project-/problem-based Learning
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1257: Fluidics	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1155: Aircraft Cabin Systems

Courses

Title	Typ	Hrs/wk	CP
Aircraft Cabin Systems (L1545)	Lecture	3	4
Aircraft Cabin Systems (L1546)	Recitation Section (large)	1	2

Module Responsible	Prof. Ralf God
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Electrical Engineering • Control Systems
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to: • describe cabin operations, equipment in the cabin and cabin Systems • explain the functional and non-functional requirements for cabin Systems • elucidate the necessity of cabin operating systems and emergency Systems • assess the challenges human factors integration in a cabin environment
Skills	Students are able to: • design a cabin layout for a given business model of an Airline • design cabin systems for safe operations • design emergency systems for safe man-machine interaction • solve comfort needs and entertainment requirements in the cabin
Personal Competence	
Social Competence	Students are able to: • understand existing system solutions and discuss their ideas with experts
Autonomy	Students are able to: • Reflect the contents of lectures and expert presentations self-dependent
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 Minutes
Assignment for the Following Curricula	Electrical Engineering: Specialisation Control and Power Systems Engineering: Elective Compulsory Energy Systems: Specialisation Energy Systems: Elective Compulsory Aircraft Systems Engineering: Core Qualification: Compulsory International Management and Engineering: Specialisation II. Aviation Systems: 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 Aircraft Systems Engineering: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

Course L1545: Aircraft Cabin Systems	
Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Ralf God
Language	DE
Cycle	WiSe
Content	The objective of the lecture with the corresponding exercise is the acquisition of knowledge about aircraft cabin systems and cabin operations. A basic understanding of technological and systems engineering effort to maintain an artificial but comfortable and safe travel and working environment at cruising altitude is to be achieved. The course provides a comprehensive overview of current technology and cabin systems in modern passenger aircraft. The Fulfillment of requirements for the cabin as the central system of work are covered on the basis of the topics comfort, ergonomics, human factors, operational processes, maintenance and energy supply: • Materials used in the cabin • Ergonomics and human factors • Cabin interior and non-electrical systems • Cabin electrical systems and lights • Cabin electronics, communication-, information- and IFE-systems • Cabin and passenger process chains • RFID Aircraft Parts Marking • Energy sources and energy conversion
Literature	- Skript zur Vorlesung - Jenkinson, L.R., Simpkin, P., Rhodes, D.: Civil Jet Aircraft Design. London: Arnold, 1999 - Rossow, C.-C., Wolf, K., Horst, P. (Hrsg.): Handbuch der Luftfahrzeugtechnik. Carl Hanser Verlag, 2014 - Moir, I., Seabridge, A.: Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration, Wiley 2008 - Davies, M.: The standard handbook for aeronautical and astronautical engineers. McGraw-Hill, 2003 - Kompendium der Flugmedizin. Verbesserte und ergänzte Neuauflage, Nachdruck April 2006. Fürstenfeldbruck, 2006 - Campbell, F.C.: Manufacturing Technology for Aerospace Structural Materials. Elsevier Ltd., 2006

Course L1546: Aircraft Cabin Systems	
Typ	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Ralf God
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1342: Polymers

Courses

Title	Typ	Hrs/wk	CP
Structure and Properties of Polymers (L0389)	Lecture	2	3
Processing and design with polymers (L1892)	Lecture	2	3

Module Responsible	Dr. Hans Wittich
Admission Requirements	None
Recommended Previous Knowledge	Basics: chemistry / physics / material science
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can use the knowledge of plastics and define the necessary testing and analysis. They can explain the complex relationships structure-property relationship and the interactions of chemical structure of the polymers, including to explain neighboring contexts (e.g. sustainability, environmental protection).
Skills	Students are capable of - using standardized calculation methods in a given context to mechanical properties (modulus, strength) to calculate and evaluate the different materials. - selecting appropriate solutions for mechanical recycling problems and sizing example stiffness, corrosion resistance.
Personal Competence	
Social Competence	Students can - arrive at funded work results in heterogenius groups and document them. - provide appropriate feedback and handle feedback on their own performance constructively.
Autonomy	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. - assess possible consequences of their professional activity.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	180 min
Assignment for the Following Curricula	Materials Science: Specialisation Engineering Materials: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Materials Science: Elective Compulsory

Course L0389: Structure and Properties of Polymers	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Hans Wittich
Language	DE
Cycle	WiSe
Content	- Structure and properties of polymers - Structure of macromolecules Constitution, Configuration, Conformation, Bonds, Synthesis, Molecular weihght distribution - Morphology amorph, crystalline, blends - Properties Elasticity, plasticity, viscoelacity - Thermal properties - Electrical properties - Theoretical modelling - Applications
Literature	Ehrenstein: Polymer-Werkstoffe, Carl Hanser Verlag

Course L1892: Processing and design with polymers	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler, Dr. Hans Wittich
Language	DE/EN
Cycle	WiSe
Content	Manufacturing of Polymers: General Properties; Calendering; Extrusion; Injection Moulding; Thermoforming, Foaming; Joining Designing with Polymers: Materials Selection; Structural Design; Dimensioning
Literature	Osswald, Menges: Materials Science of Polymers for Engineers, Hanser Verlag Crawford: Plastics engineering, Pergamon Press Michaeli: Einführung in die Kunststoffverarbeitung, Hanser Verlag Konstruieren mit Kunststoffen, Gunter Erhard , Hanser Verlag

Module M1185: Technical Complementary Course for PEPMS (according to Subject Specific Regulations)

Courses			
Title	**Typ**	**Hrs/wk**	**CP**

Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous Knowledge	See selected module according to FSPO
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	see selected module according to FSPO
Skills	see selected module according to FSPO
Personal Competence	
Social Competence	see selected module according to FSPO
Autonomy	see selected module according to FSPO
Workload in Hours	Depends on choice of courses
Credit points	6
Assignment for the Following Curricula	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

Specialization Materials

Graduates of the discipline materials are able to work in the development, production and application of materials based on a natural scientific education. The material-oriented graduates can identify new fields of application and make the application-specific selection of the material under consideration of function, costs and quality.

Module M0763: Aircraft Systems I

Courses

Title	Typ	Hrs/wk	CP
Aircraft Systems I (L0735)	Lecture	3	4
Aircraft Systems I (L0739)	Recitation Section (large)	2	2

Module Responsible	Prof. Frank Thielecke
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Electrical Engineering • Hydraulics • Control Systems
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to: • Describe essential components and design points of hydraulic, electrical and high-lift systems • Give an overview of the functionality of air conditioning systems • Explain the need for high-lift systems such as ist functionality and effects • Assess the challenge during the design of supply systems of an aircraft
Skills	Students are able to: • Design hydraulic and electric supply systems of aircrafts • Design high-lift systems of aircrafts • Analyze the thermodynamic behaviour of air conditioning systems
Personal Competence	
Social Competence	Students are able to: • Perform system design in groups and present and discuss results
Autonomy	Students are able to: • Reflect the contents of lectures autonomously
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	165 Minutes
Assignment for the Following Curricula	Energy Systems: Specialisation Energy Systems: Elective Compulsory Aircraft Systems Engineering: Core Qualification: Compulsory International Management and Engineering: Specialisation II. Aviation Systems: 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory

Course L0735: Aircraft Systems I	
Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	WiSe
Content	• Hydraulic Energy Systems (Fluids; pressure loss in valves and pipes; components of hydraulic systems like pumps, valves, etc.; pressure/flow characteristics; actuators; tanks; power and heat balances; emergency power) • Electric Energy Systems (Generators; constant-speed-drives; DC and AC converters; electrical power distribution; bus systems; monitoring; load analysis) • High Lift Systems (Principles; investigation of loads and system actuation power; principles and sizing of actuation and positioning systems; safety requirements and devices) • Environmental Control Systems (Thermodynamic analysis; expansion and compression cooling systems; control strategies; cabin pressure control systems)
Literature	• Moir, Seabridge: Aircraft Systems • Green: Aircraft Hydraulic Systems • Torenbek: Synthesis of Subsonic Airplane Design • SAE1991: ARP; Air Conditioning Systems for Subsonic Airplanes

Course L0739: Aircraft Systems I	
Typ	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1141: Selected Topics of Product Development, Materials Science and Production (Alternative A: 12 LP)

Courses

Title	Typ	Hrs/wk	CP
Applied Automation (L1592)	Project-/problem-based Learning	3	3
Ergonomics (L0653)	Lecture	2	3
Elements of Integrated Production Systems (L0927)	Project-/problem-based Learning	2	3
Emotional Design / User Centered Product Development (L1703)	Seminar	2	2
Development Management for Mechatronics (L1512)	Lecture	2	3
Fatigue & Damage Tolerance (L0310)	Lecture	2	3
Industry 4.0 for engineers (L2012)	Lecture	2	3
Innovation and Product Management (L2168)	Seminar	2	3
Lightweight Construction with Fibre Reinforced Rolymers - Structural Mechanics (L1514)	Lecture	2	3
Lightweight Design Practical Course (L1258)	Project-/problem-based Learning	3	3
Mechanisms, Systems and Processes of Materials Testing (L0950)	Lecture	2	2
Microsystems Technology (L0724)	Lecture	2	4
Productivity Management (L0928)	Project-/problem-based Learning	2	2
Productivity Management (L0931)	Recitation Section (small)	1	1
Feedback Control in Medical Technology (L0664)	Lecture	2	3
Renewable Energy (L0313)	Lecture	2	2
Renewable Energy (L1434)	Recitation Section (small)	1	1
Six Sigma (L1130)	Lecture	2	3
System Simulation (L1820)	Lecture	2	2
System Simulation (L1821)	Recitation Section (large)	1	2
Technical Design (L1513)	Lecture	2	3
Ceramics Technology (L0379)	Lecture	2	3
Materials Testing (L0949)	Lecture	2	2
Reliability in Engineering Dynamics (L0176)	Lecture	2	2
Reliability in Engineering Dynamics (L1303)	Recitation Section (small)	1	2
Reliability of Aircraft Systems (L0749)	Lecture	2	3

Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous Knowledge	None
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students are able to express their extended knowledge and discuss the connection of different special fields or application areas of product development, materials and production • Students are qualified to connect different special fields with each other
Skills	• Students can apply specialized solution strategies and new scientific methods in selected areas • Students are able to transfer learned skills to new and unknown problems and can develop own solution approaches
Personal Competence	
Social Competence	-
Autonomy	• Students are able to develop their knowledge and skills by autonomous election of courses.
Workload in Hours	Depends on choice of courses
Credit points	12
Assignment for the Following Curricula	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

Course L1592: Applied Automation	
Typ	Project-/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 Minuten
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	-Project Based Learning -Robot Operating System -Robot structure and description -Motion description -Calibration -Accuracy
Literature	John J. Craig Introduction to Robotics – Mechanics and Control ISBN: 0131236296 Pearson Education, Inc., 2005 Stefan Hesse Grundlagen der Handhabungstechnik ISBN: 3446418725 München Hanser, 2010 K. Thulasiraman and M. N. S. Swamy Graphs: Theory and Algorithms ISBN: 9781118033104 John Wüey & Sons, Inc., 1992

Course L0653: Ergonomics	
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	30 Minuten
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	

Course L0927: Elements of Integrated Production Systems	
Typ	Project-/problem-based Learning
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. Hermann Lödding
Language	DE
Cycle	SoSe
Content	not available
Literature	Harris, R.; Harris, C.; Wilson, E.: Making Materials Flow, Lean Enterprise Institute, Cambridge, 2003. Ohno, T.: Das Toyota-Produktionssystem, Campus-Verlag, Frankfurt et al, 1993. Rother, M.: Die Kata des Weltmarktführers. Toyotas Erfolgsmethoden, Campus-Verlag, Frankfurt et al, 2009. Rother, M.; Shook, J.: Sehen lernen: Mit Wertstromdesign die Wertschöpfung erhöhen und Verschwendung beseitigen, Lean Management Institut, Aachen, 2006. Rother, M.; Harris, R.: Creating Continuous Flow, Lean Enterprise Institute, Brookline, 2001. Shingo, S.: A Revolution in Manufacturing. The SMED System, Productivity Press, 2006. Womack, J. P. et al: Die zweite Revolution in der Autoindustrie, Frankfurt/New York, Campus Verlag, 1992.

Course L1703: Emotional Design / User Centered Product Development	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	Teamarbeit und abschließender Vortrag
Lecturer	Jörg Heuser
Language	DE
Cycle	SoSe
Content	Lecture • Objective and subjective perception for the evaluation of product characteristics • Effects of material, color, shape and structure to the acceptance of a product • Aesthetic function of a product • Case studies, lack of acceptance of a product and possible reason Seminar • Identification of non-technical product functions • Identification of subjective influences for the product development Project Work • Topics will be developed in cooperation with the students. Project works will be presented in teams, presented and evaluated Exemplary Project: Holistic product evaluation, product optimization
Literature	Wird in der Veranstaltung angegeben

Course L1512: Development Management for Mechatronics	
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	30 Minuten
Lecturer	Dr. Daniel Steffen
Language	DE
Cycle	SoSe
Content	• Processes and methods of product development - from idea to market launch ◦ identification of market and technology potentials ◦ development of a common product architecture ◦ Synchronized product development across all engineering disciplines ◦ product validation incl. customer view • Steering and optimization of product development ◦ Design of processes for product development ◦ IT systems for product development ◦ Establishment of management standards ◦ Typical types of organization
Literature	• Bender: Embedded Systems - qualitätsorientierte Entwicklung • Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit • Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen • Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung • Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden • Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung • VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme

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. Kluver Academic Puplisher, Dordrecht, 2001 E. Haibach. Betriebsfestigkeit Verfahren und Daten zur Bauteilberechnung. VDI-Verlag, Düsseldorf, 1989

Course L2012: Industry 4.0 for engineers	
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 min
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	
Literature	

Course L2168: Innovation and Product Management	
Typ	Seminar
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	30 min
Lecturer	Dr. Christoph Fuchs
Language	DE
Cycle	SoSe
Content	
Literature	

Course L1514: Lightweight Construction with Fibre Reinforced Rolymers - Structural Mechanics	
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	30 min
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	WiSe
Content	**Fundamentals of Anisotropic Elasticity** Displacements, strains and stresses; Equilibrium equations; Kinematics; Hooke's generalized law **Behaviour of a single laminate layer** Material law of a single laminate layer; Full anisotropy and coupling effects; Material symmetries; Engineering constants; Plane state of stress; Transformation rules **Fundamentals of Micromechanics of a laminate layer** Representative unit cell; Determination of effective material constants; Effective stiffness properties of a single layer **Classical Laminate Plate Theory** Notations and laminate code; Kinematics and displacement field; Strains and stresses, stress resultants; Constitutive equations and coupling effects; Special laminates and their behavior; Effective laminate properties **Strength of Laminated Plates** Fundamental concept; Phenomenological failure criteria: maximum stresses, maximum strains, Tsai-Hill, Tsai-Wu, Puck, Hashin **Bending of Composite Laminated Plates** Differential Equations; Boundary Conditions; Navier-type solutions; Lévy-type solutions **Stress Concentration Problems** Free-edge effects; Stress concentrations at holes, cracks, delaminations; Aspects of failure analysis **Stability of Thin-Walled Composite Structures** Buckling of anisotropic plates and shells; Influence of loading conditions; Influence of boundary conditions; Exact transcendental solutions and their evaluation; Buckling of stiffened composite plates; Minimum stiffness requirements; Local buckling of stiffener profiles **Written exercise (report required)** Assessment of a thin-walled composite laminated beam taking several different dimensioning criteria into account
Literature	• Schürmann, H., „Konstruieren mit Faser-Kunststoff-Verbunden“, Springer, Berlin, aktuelle Auflage. • Wiedemann, J., „Leichtbau Band 1: Elemente“, Springer, Berlin, Heidelberg, , aktuelle Auflage. • Reddy, J.N., „Mechanics of Composite Laminated Plates and Shells”, CRC Publishing, Boca Raton et al., current edition. • Jones, R.M., „Mechanics of Composite Materials“, Scripta Book Co., Washington, current edition. • Timoshenko, S.P., Gere, J.M., „Theory of elastic stability“, McGraw-Hill Book Company, Inc., New York, current edition. • Turvey, G.J., Marshall, I.H., „Buckling and postbuckling of composite plates“, Chapman and Hall, London, current edition. • Herakovich, C.T., „Mechanics of fibrous composites“, John Wiley and Sons, Inc., New York, current edition. • Mittelstedt, C., Becker, W., „Strukturmechanik ebener Laminate”, aktuelle Auflage.

Course L1258: Lightweight Design Practical Course	
Typ	Project-/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/EN
Cycle	SoSe
Content	Development of a sandwich structure made of fibre reinforced plastics • getting familiar with fibre reinforced plastics as well as lightweight design • Design of a sandwich structure made of fibre reinforced plastics using finite element analysis (FEA) • Determination of material properties based on sample tests • manufacturing of the structure in the composite lab • Testing of the developed structure • Concept presentation • Self-organised teamwork
Literature	• Schürmann, H., „Konstruieren mit Faser-Kunststoff-Verbunden“, Springer, Berlin, 2005. • Puck, A., „Festigkeitsanalsyse von Faser-Matrix-Laminaten“, Hanser, München, Wien, 1996. • R&G, „Handbuch Faserverbundwerkstoffe“, Waldenbuch, 2009. • VDI 2014 „Entwicklung von Bauteilen aus Faser-Kunststoff-Verbund“ • Ehrenstein, G. W., „Faserverbundkunststoffe“, Hanser, München, 2006. • Klein, B., „Leichtbau-Konstruktion", Vieweg & Sohn, Braunschweig, 1989. • Wiedemann, J., „Leichtbau Band 1: Elemente“, Springer, Berlin, Heidelberg, 1986. • Wiedemann, J., „Leichtbau Band 2: Konstruktion“, Springer, Berlin, Heidelberg, 1986. • Backmann, B.F., „Composite Structures, Design, Safety and Innovation”, Oxford (UK), Elsevier, 2005. • Krause, D., „Leichtbau”, In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012. • Schulte, K., Fiedler, B., „Structure and Properties of Composite Materials”, Hamburg, TUHH - TuTech Innovation GmbH, 2005.

Course L0950: Mechanisms, Systems and Processes of Materials Testing	
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	Dr. Jan Oke Peters
Language	DE
Cycle	SoSe
Content	Application, analysis and discussion of basic and advanced testing methods to ensure correct selection of applicable testing procedure for investigation of part/materials deficiencies • Stress-strain relationships • Strain gauge application • Visko elastic behavior • Tensile test (strain hardening, necking, strain rate) • Compression test, bending test, torsion test • Crack growth upon static loading (J-Integral) • Crack growth upon cyclic loading (micro- und macro cracks) • Effect of notches • Creep testing (physical creep test, influence of stress and temperature, Larson Miller parameter) • Wear testing • Non destructive testing application for overhaul of jet engines
Literature	• E. Macherauch: Praktikum in Werkstoffkunde, Vieweg • G. E. Dieter: Mechanical Metallurgy, McGraw-Hill • R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg • R. Bürgel: Werkstoffe sícher beurteilen und richtig einsetzen, Vieweg

Course L0724: Microsystems Technology	
Typ	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cycle	WiSe
Content	• Introduction (historical view, scientific and economic relevance, scaling laws) • Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution, next-generation lithography, nano-imprinting, molecular imprinting) • Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVD, LPCVD, PECVD and LECVD; screen printing) • Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA, electrochemical etching, anisotropic etching with KOH/TMAH: theory, corner undercutting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering, plasma etching, RIE, Bosch process, cryo process, XeF2 etching) • Surface Micromachining and alternative Techniques (sacrificial etching, film stress, stiction: theory and counter measures; Origami microstructures, Epi-Poly, porous silicon, SOI, SCREAM process, LIGA, SU8, rapid prototyping) • Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensors: thermo resistor, Pt-100, spreading resistance sensor, pn junction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry, IR sensor: thermopile and bolometer) • Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistivity, pressure sensor: piezoresistive, capacitive and fabrication process; accelerometer: piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process) • Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensors: magneto resistance, AMR and GMR, fluxgate magnetometer) • Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; metal oxide semiconductor gas sensor, organic semiconductor gas sensor, Lambda probe, MOSFET gas sensor, pH-FET, SAW sensor, principle of biosensor, Clark electrode, enzyme electrode, DNA chip) • Micro Actuators, Microfluidics and TAS (drives: thermal, electrostatic, piezo electric and electromagnetic; light modulators, DMD, adaptive optics, microscanner, microvalves: passive and active, micropumps, valveless micropump, electrokinetic micropumps, micromixer, filter, inkjet printhead, microdispenser, microfluidic switching elements, microreactor, lab-on-a-chip, microanalytics) • MEMS in medical Engineering (wireless energy and data transmission, smart pill, implantable drug delivery system, stimulators: microelectrodes, cochlear and retinal implant; implantable pressure sensors, intelligent osteosynthesis, implant for spinal cord regeneration) • Design, Simulation, Test (development and design flows, bottom-up approach, top-down approach, testability, modelling: multiphysics, FEM and equivalent circuit simulation; reliability test, physics-of-failure, Arrhenius equation, bath-tub relationship) • System Integration (monolithic and hybrid integration, assembly and packaging, dicing, electrical contact: wire bonding, TAB and flip chip bonding; packages, chip-on-board, wafer-level-package, 3D integration, wafer bonding: anodic bonding and silicon fusion bonding; micro electroplating, 3D-MID)
Literature	M. Madou: Fundamentals of Microfabrication, CRC Press, 2002 N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009 T. M. Adams, R. A. Layton:Introductory MEMS, Springer, 2010 G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008

Course L0928: Productivity Management	
Typ	Project-/problem-based Learning
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. Hermann Lödding
Language	DE
Cycle	SoSe
Content	• Principles of productivity management • Shop floor management and standardisation • Takt analysis and design of manual operations • Maintenance Principles • Total Productive Maintenance (TPM) • Optimisation of set-up operations • Analysis of interlinked production systems
Literature	Bokranz, R.; Landau, K.:Produktivitätsmanagement von Arbeitssystemen. Schäffer-Poeschel, Stuttgart, 2006. Takeda, H.: Das synchrone Produktionssystem: Just-in-Time für das ganze Unternehmen. 5. Aufl., mi-Wirtschaftsbuch, FinanzBuch Verlag, München, 2006. Nakajima, S.: Management der Produktionseinrichtungen (Total Productive Maintenance). Campus Verlag, New York, 1995. Shingo, S.: A Revolution in Manufacturing: The SMED System. Productivity, Inc., 1985

Course L0931: Productivity Management	
Typ	Recitation Section (small)
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. Hermann Lödding
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0664: Feedback Control in Medical Technology	
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	20 min
Lecturer	Johannes Kreuzer, Christian Neuhaus
Language	DE
Cycle	SoSe
Content	Always viewed from the engineer's point of view, the lecture is structured as follows: • Introduction to the topic • Fundamentals of physiological modelling • Introduction to Breathing and Ventilation • Physiology and Pathology in Cardiology • Introduction to the Regulation of Blood Glucose • kidney function and renal replacement therapy • Representation of the control technology on the concrete ventilator • Excursion to a medical technology company Techniques of modeling, simulation and controller development are discussed. In the models, simple equivalent block diagrams for physiological processes are derived and explained how sensors, controllers and actuators are operated. MATLAB and SIMULINK are used as development tools.
Literature	• Leonhardt, S., & Walter, M. (2016). Medizintechnische Systeme. Berlin, Heidelberg: Springer Vieweg. • Werner, J. (2005). Kooperative und autonome Systeme der Medizintechnik. München: Oldenbourg. • Oczenski, W. (2017). Atmen : Atemhilfen ; Atemphysiologie und Beatmungstechnik: Georg Thieme Verlag KG.

Course L0313: Renewable Energy	
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. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	• introduction • solar energy for heat and power generation • wind power for electricity generation • hydropower for electricity generation • ocean energy for electricity generation • geothermal energy for heat and electricty generation
Literature	• Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage • Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg,2007

Course L1434: Renewable Energy	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	60 Minuten
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	Students work on different tasks in the field of renewable energies. They present their solutions in the exercise lesson and discuss it with other students and the lecturer. Possible tasks in the field of renewable energies are: • Solar thermal heat • Concentrating solare power • Photovoltaic • Windenergie • Hydropower • Heat pump • Deep geothermal energy
Literature	• Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage • Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg,2007

Course L1130: Six Sigma	
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. Claus Emmelmann
Language	DE
Cycle	WiSe
Content	• Introduction and structuring • Basic terms of quality management • Measuring and inspection equipment • Tools of quality management: FMEA, QFD, FTA, etc. • Quality management methodology Six Sigma, DMAIC
Literature	Pfeifer, T.: Qualitätsmanagement : Strategien, Methoden, Techniken, 4. Aufl., München 2008 Pfeifer, T.: Praxishandbuch Qualitätsmanagement, München 1996 Geiger, W., Kotte, W.: Handbuch Qualität : Grundlagen und Elemente des Qualitätsmanagements: Systeme, Perspektiven, 5. Aufl., Wiesbaden 2008

Course L1820: System Simulation	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Stefan Wischhusen
Language	DE
Cycle	WiSe
Content	All participants must bring a notebook, to install and use the software OpenModelica. • Instruction and modelling of physical processes • Modelling and limits of model • Time constant, stiffness, stability, step size • Terms of object orientated programming • Differential equations of simple systems • Introduction into Modelica • Introduction into simulation tool • Example: Heat transfer • Example: System with different subsystems
Literature	[1] Modelica Association: "Modelica Language Specification - Version 3.3", Linköping, Sweden, 2 0 1 2 [2] M. Tiller: “Modelica by Example", http://book.xogeny.com, 2014. [3] M. Otter, H. Elmqvist, et al.: "Objektorientierte Modellierung Physikalischer Systeme", at- Automatisierungstechnik (german), Teil 1 - 17, Oldenbourg Verlag, 1999 - 2000. [4] P. Fritzson: "Principles of Object-Oriented Modeling and Simulation with Modelica 3.3", Wiley-IEEE Press, New York, 2015. [5] P. Fritzson: “Introduction to Modeling and Simulation of Technical and Physical Systems with Modelica”, Wiley, New York, 2011.

Course L1821: System Simulation	
Typ	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Stefan Wischhusen
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1513: Technical Design	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	10-15 Entwurfszeichnungen, Skizzen und ca. 5-10 A4-Dokumentationsseiten (Themen- und Entwurfsbegründung)
Lecturer	Prof. Werner Granzeier
Language	DE
Cycle	SoSe
Content	• Basics with analysis, concept, proposal drawings and sketches • Samples from practice of technical industrial design • Product concept with new ideas and package • ID proposal with structural concept and external product ergonomics • Visualisation and presentation of the overall concept • Realization as individual case studies
Literature	Literatur über technisches Produktdesign Technisches Rendering und Präsentation

Zeichnen und perspektivisches Entwerfen

Literaturhinweise

What is Product Design ?

Laura Slack

RotoVision Schweiz 2006

Product Design Now

Design and Scetches

CollinsDesign and maomao publications Spanien 2006

Ronald B. Kemnitzer, Rendering With Markers - Definitive Techniques

for Designers, Illustrators and Architects,

Watson, Guptil Puplications,a division of Billboard Publications Inc.,

New York 1983

Creative Techniques

DRAWING

Barons Educational Series

ISBN-13: 978-0-7641-6182-7

Joseph Ungar, Rendering In Mixed Media - Techniques for Concept

Presentation for Designers and Illustrators

Watson-Guptil Publication a division of Billboard Publications Inc.,

New York 1985

AIRWORLD

Design und Architektur für die Flugreise

Vitra Design Stiftung   Weil am Rhein 2004

Airline Design

Perter Deslius Jacek Slaski te Neues 2005

Technik und Sicherheit von Passagierflugzeugen

Frank Littek

Motorbuch Verlag 2003

Jetliner Cabins

Jennifer Coutts Clay

Cs books   England 2006

BOEING Widebodies

Michael Haenggi   motorbooks international USA 2003

form - Zeitschrift für Gestaltung, Verlag form GmbH,

Hofgut Ober-Berrbach, 6104 Seeheim-Jugenheim

(erscheint vierteljährlich, Verlag form GmbH)

design report

german magasin,

(erscheint monatlich)

md - möbel interior design, Konradin-Verlag

Robert Kohlhammer GmbH, 7022 Leinfelden-Echterdingen

(erscheint monatlich)

CAR STYLING, Car Styling Publishing Co. 4-8-16-11F,

Kitashinjuku, Shinjuku-ku, Tokio 160, Japan

(erscheint vierteljährlich in japanischer und englischer Sprache, in Hamburg erhältlich bei: Overseas Courier Service Deutschland GmbH,

Auto & Design,

Corso Frabcia 161, 10139 Torino, Italia

	(erscheint vierteljährlich in italienischer und englischer Sprache alle zwei Monate , erhältlich am HBF Hamburg AERO International, Magazin für Zivilluftfahrt (erscheint monatlich) Aircraft interior international Engl. magasin for Aircraft cabin interior (erscheint 2 monatlich) aerotec Technik- und Branchenmagazin für die Luft- und Raumfahrtindustrie

Course L0379: Ceramics Technology	
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	Dr. Rolf Janßen
Language	DE/EN
Cycle	WiSe
Content	Introduction to ceramic processing with emphasis on advanced structural ceramics. The course focus predominatly on powder-based processing, e.g. “powder-metauurgical techniques and sintering (soild state and liquid phase). Also, some aspects of glass and cement science as well as new developments in powderless forming techniques of ceramics and ceramic composites will be addressed Examples will be discussed in order to give engineering students an understanding of technology development and specific applications of ceramic components. **Content:** 1. Introduction Inhalt: 2. Raw materials 3. Powder fabrication 4. Powder processing 5. Shape-forming processes 6. Densification, sintering 7. Glass and Cement technology 8. Ceramic-metal joining techniques
Literature	W.D. Kingery, „Introduction to Ceramics“, John Wiley & Sons, New York, 1975 ASM Engineering Materials Handbook Vol.4 „Ceramics and Glasses“, 1991 D.W. Richerson, „Modern Ceramic Engineering“, Marcel Decker, New York, 1992 Skript zur Vorlesung

Course L0949: Materials Testing	
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	Dr. Jan Oke Peters
Language	DE
Cycle	WiSe
Content	Application and analysis of basic mechanical as well as non-destructive testing of materials • Determination elastic constants • Tensile test • Fatigue test (testing with constant stress, strain, or plastiv strain amplitude, low and high cycle fatigue, mean stress effect) • Crack growth upon static loading (stress intensity factor, fracture toughness) • Creep test • Hardness test • Charpy impact test • Non destructive testing
Literature	E. Macherauch: Praktikum in Werkstoffkunde, Vieweg G. E. Dieter: Mechanical Metallurgy, McGraw-Hill

Course L0176: Reliability in Engineering Dynamics	
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 min.
Lecturer	Prof. Uwe Weltin
Language	EN
Cycle	SoSe
Content	Method for calculation and testing of reliability of dynamic machine systems • Modeling • System identification • Simulation • Processing of measurement data • Damage accumulation • Test planning and execution
Literature	Bertsche, B.: Reliability in Automotive and Mechanical Engineering. Springer, 2008. ISBN: 978-3-540-33969-4 Inman, Daniel J.: Engineering Vibration. Prentice Hall, 3rd Ed., 2007. ISBN-13: 978-0132281737 Dresig, H., Holzweißig, F.: Maschinendynamik, Springer Verlag, 9. Auflage, 2009. ISBN 3540876936. VDA (Hg.): Zuverlässigkeitssicherung bei Automobilherstellern und Lieferanten. Band 3 Teil 2, 3. überarbeitete Auflage, 2004. ISSN 0943-9412

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

Course L0749: Reliability of Aircraft Systems	
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. Frank Thielecke, Dr. Andreas Vahl, Dr. Uwe Wieczorek
Language	DE
Cycle	WiSe
Content	• Functions of reliability and safety (regulations, certification requirements) • Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment) • Reliability analysis of electrical and mechanical systems
Literature	• CS 25.1309 • SAE ARP 4754 • SAE ARP 4761

Module M1209: Selected Topics of Product Development, Materials Science and Production (Alternative B: 6 LP)

Courses

Title	Typ	Hrs/wk	CP
Applied Automation (L1592)	Project-/problem-based Learning	3	3
Ergonomics (L0653)	Lecture	2	3
Elements of Integrated Production Systems (L0927)	Project-/problem-based Learning	2	3
Emotional Design / User Centered Product Development (L1703)	Seminar	2	2
Development Management for Mechatronics (L1512)	Lecture	2	3
Fatigue & Damage Tolerance (L0310)	Lecture	2	3
Industry 4.0 for engineers (L2012)	Lecture	2	3
Innovation and Product Management (L2168)	Seminar	2	3
Lightweight Construction with Fibre Reinforced Rolymers - Structural Mechanics (L1514)	Lecture	2	3
Lightweight Design Practical Course (L1258)	Project-/problem-based Learning	3	3
Mechanisms, Systems and Processes of Materials Testing (L0950)	Lecture	2	2
Microsystems Technology (L0724)	Lecture	2	4
Productivity Management (L0928)	Project-/problem-based Learning	2	2
Productivity Management (L0931)	Recitation Section (small)	1	1
Feedback Control in Medical Technology (L0664)	Lecture	2	3
Renewable Energy (L0313)	Lecture	2	2
Renewable Energy (L1434)	Recitation Section (small)	1	1
Six Sigma (L1130)	Lecture	2	3
System Simulation (L1820)	Lecture	2	2
System Simulation (L1821)	Recitation Section (large)	1	2
Technical Design (L1513)	Lecture	2	3
Ceramics Technology (L0379)	Lecture	2	3
Materials Testing (L0949)	Lecture	2	2
Reliability in Engineering Dynamics (L0176)	Lecture	2	2
Reliability in Engineering Dynamics (L1303)	Recitation Section (small)	1	2
Reliability of Aircraft Systems (L0749)	Lecture	2	3

Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous Knowledge	None
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students are able to express their extended knowledge and discuss the connection of different special fields or application areas of product development, materials and production • Students are qualified to connect different special fields with each other
Skills	• Students can apply specialized solution strategies and new scientific methods in selected areas • Students are able to transfer learned skills to new and unknown problems and can develop own solution approaches
Personal Competence	
Social Competence	-
Autonomy	• Students are able to develop their knowledge and skills by autonomous election of courses.
Workload in Hours	Depends on choice of courses
Credit points	6
Assignment for the Following Curricula	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

Course L1592: Applied Automation	
Typ	Project-/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 Minuten
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	-Project Based Learning -Robot Operating System -Robot structure and description -Motion description -Calibration -Accuracy
Literature	John J. Craig Introduction to Robotics – Mechanics and Control ISBN: 0131236296 Pearson Education, Inc., 2005 Stefan Hesse Grundlagen der Handhabungstechnik ISBN: 3446418725 München Hanser, 2010 K. Thulasiraman and M. N. S. Swamy Graphs: Theory and Algorithms ISBN: 9781118033104 John Wüey & Sons, Inc., 1992

Course L0653: Ergonomics	
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	30 Minuten
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	

Course L0927: Elements of Integrated Production Systems	
Typ	Project-/problem-based Learning
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. Hermann Lödding
Language	DE
Cycle	SoSe
Content	not available
Literature	Harris, R.; Harris, C.; Wilson, E.: Making Materials Flow, Lean Enterprise Institute, Cambridge, 2003. Ohno, T.: Das Toyota-Produktionssystem, Campus-Verlag, Frankfurt et al, 1993. Rother, M.: Die Kata des Weltmarktführers. Toyotas Erfolgsmethoden, Campus-Verlag, Frankfurt et al, 2009. Rother, M.; Shook, J.: Sehen lernen: Mit Wertstromdesign die Wertschöpfung erhöhen und Verschwendung beseitigen, Lean Management Institut, Aachen, 2006. Rother, M.; Harris, R.: Creating Continuous Flow, Lean Enterprise Institute, Brookline, 2001. Shingo, S.: A Revolution in Manufacturing. The SMED System, Productivity Press, 2006. Womack, J. P. et al: Die zweite Revolution in der Autoindustrie, Frankfurt/New York, Campus Verlag, 1992.

Course L1703: Emotional Design / User Centered Product Development	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and scale	Teamarbeit und abschließender Vortrag
Lecturer	Jörg Heuser
Language	DE
Cycle	SoSe
Content	Lecture • Objective and subjective perception for the evaluation of product characteristics • Effects of material, color, shape and structure to the acceptance of a product • Aesthetic function of a product • Case studies, lack of acceptance of a product and possible reason Seminar • Identification of non-technical product functions • Identification of subjective influences for the product development Project Work • Topics will be developed in cooperation with the students. Project works will be presented in teams, presented and evaluated Exemplary Project: Holistic product evaluation, product optimization
Literature	Wird in der Veranstaltung angegeben

Course L1512: Development Management for Mechatronics	
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	30 Minuten
Lecturer	Dr. Daniel Steffen
Language	DE
Cycle	SoSe
Content	• Processes and methods of product development - from idea to market launch ◦ identification of market and technology potentials ◦ development of a common product architecture ◦ Synchronized product development across all engineering disciplines ◦ product validation incl. customer view • Steering and optimization of product development ◦ Design of processes for product development ◦ IT systems for product development ◦ Establishment of management standards ◦ Typical types of organization
Literature	• Bender: Embedded Systems - qualitätsorientierte Entwicklung • Ehrlenspiel: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit • Gausemeier/Ebbesmeyer/Kallmeyer: Produktinnovation - Strategische Planung und Entwicklung der Produkte von morgen • Haberfellner/de Weck/Fricke/Vössner: Systems Engineering: Grundlagen und Anwendung • Lindemann: Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden • Pahl/Beitz: Konstruktionslehre: Grundlagen erfolgreicher Produktentwicklung. Methoden und Anwendung • VDI-Richtlinie 2206: Entwicklungsmethodik für mechatronische Systeme

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. Kluver Academic Puplisher, Dordrecht, 2001 E. Haibach. Betriebsfestigkeit Verfahren und Daten zur Bauteilberechnung. VDI-Verlag, Düsseldorf, 1989

Course L2012: Industry 4.0 for engineers	
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 min
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	
Literature	

Course L2168: Innovation and Product Management	
Typ	Seminar
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	30 min
Lecturer	Dr. Christoph Fuchs
Language	DE
Cycle	SoSe
Content	
Literature	

Course L1514: Lightweight Construction with Fibre Reinforced Rolymers - Structural Mechanics	
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	30 min
Lecturer	Prof. Benedikt Kriegesmann
Language	DE
Cycle	WiSe
Content	**Fundamentals of Anisotropic Elasticity** Displacements, strains and stresses; Equilibrium equations; Kinematics; Hooke's generalized law **Behaviour of a single laminate layer** Material law of a single laminate layer; Full anisotropy and coupling effects; Material symmetries; Engineering constants; Plane state of stress; Transformation rules **Fundamentals of Micromechanics of a laminate layer** Representative unit cell; Determination of effective material constants; Effective stiffness properties of a single layer **Classical Laminate Plate Theory** Notations and laminate code; Kinematics and displacement field; Strains and stresses, stress resultants; Constitutive equations and coupling effects; Special laminates and their behavior; Effective laminate properties **Strength of Laminated Plates** Fundamental concept; Phenomenological failure criteria: maximum stresses, maximum strains, Tsai-Hill, Tsai-Wu, Puck, Hashin **Bending of Composite Laminated Plates** Differential Equations; Boundary Conditions; Navier-type solutions; Lévy-type solutions **Stress Concentration Problems** Free-edge effects; Stress concentrations at holes, cracks, delaminations; Aspects of failure analysis **Stability of Thin-Walled Composite Structures** Buckling of anisotropic plates and shells; Influence of loading conditions; Influence of boundary conditions; Exact transcendental solutions and their evaluation; Buckling of stiffened composite plates; Minimum stiffness requirements; Local buckling of stiffener profiles **Written exercise (report required)** Assessment of a thin-walled composite laminated beam taking several different dimensioning criteria into account
Literature	• Schürmann, H., „Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, aktuelle Auflage. • Wiedemann, J., „Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, , aktuelle Auflage. • Reddy, J.N., „Mechanics of Composite Laminated Plates and Shells", CRC Publishing, Boca Raton et al., current edition. • Jones, R.M., „Mechanics of Composite Materials", Scripta Book Co., Washington, current edition. • Timoshenko, S.P., Gere, J.M., „Theory of elastic stability", McGraw-Hill Book Company, Inc., New York, current edition. • Turvey, G.J., Marshall, I.H., „Buckling and postbuckling of composite plates", Chapman and Hall, London, current edition. • Herakovich, C.T., „Mechanics of fibrous composites", John Wiley and Sons, Inc., New York, current edition. • Mittelstedt, C., Becker, W., „Strukturmechanik ebener Laminate", aktuelle Auflage.

Course L1258: Lightweight Design Practical Course	
Typ	Project-/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/EN
Cycle	SoSe
Content	Development of a sandwich structure made of fibre reinforced plastics • getting familiar with fibre reinforced plastics as well as lightweight design • Design of a sandwich structure made of fibre reinforced plastics using finite element analysis (FEA) • Determination of material properties based on sample tests • manufacturing of the structure in the composite lab • Testing of the developed structure • Concept presentation • Self-organised teamwork
Literature	• Schürmann, H., „Konstruieren mit Faser-Kunststoff-Verbunden“, Springer, Berlin, 2005. • Puck, A., „Festigkeitsanalsyse von Faser-Matrix-Laminaten“, Hanser, München, Wien, 1996. • R&G, „Handbuch Faserverbundwerkstoffe“, Waldenbuch, 2009. • VDI 2014 „Entwicklung von Bauteilen aus Faser-Kunststoff-Verbund“ • Ehrenstein, G. W., „Faserverbundkunststoffe“, Hanser, München, 2006. • Klein, B., „Leichtbau-Konstruktion", Vieweg & Sohn, Braunschweig, 1989. • Wiedemann, J., „Leichtbau Band 1: Elemente“, Springer, Berlin, Heidelberg, 1986. • Wiedemann, J., „Leichtbau Band 2: Konstruktion“, Springer, Berlin, Heidelberg, 1986. • Backmann, B.F., „Composite Structures, Design, Safety and Innovation”, Oxford (UK), Elsevier, 2005. • Krause, D., „Leichtbau”, In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012. • Schulte, K., Fiedler, B., „Structure and Properties of Composite Materials”, Hamburg, TUHH - TuTech Innovation GmbH, 2005.

Course L0950: Mechanisms, Systems and Processes of Materials Testing	
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	Dr. Jan Oke Peters
Language	DE
Cycle	SoSe
Content	Application, analysis and discussion of basic and advanced testing methods to ensure correct selection of applicable testing procedure for investigation of part/materials deficiencies • Stress-strain relationships • Strain gauge application • Visko elastic behavior • Tensile test (strain hardening, necking, strain rate) • Compression test, bending test, torsion test • Crack growth upon static loading (J-Integral) • Crack growth upon cyclic loading (micro- und macro cracks) • Effect of notches • Creep testing (physical creep test, influence of stress and temperature, Larson Miller parameter) • Wear testing • Non destructive testing application for overhaul of jet engines
Literature	• E. Macherauch: Praktikum in Werkstoffkunde, Vieweg • G. E. Dieter: Mechanical Metallurgy, McGraw-Hill • R. Bürgel: Lehr- und Übungsbuch Festigkeitslehre, Vieweg • R. Bürgel: Werkstoffe sícher beurteilen und richtig einsetzen, Vieweg

Course L0724: Microsystems Technology	
Typ	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Prof. Hoc Khiem Trieu
Language	EN
Cycle	WiSe
Content	• Introduction (historical view, scientific and economic relevance, scaling laws) • Semiconductor Technology Basics, Lithography (wafer fabrication, photolithography, improving resolution, next-generation lithography, nano-imprinting, molecular imprinting) • Deposition Techniques (thermal oxidation, epitaxy, electroplating, PVD techniques: evaporation and sputtering; CVD techniques: APCVD, LPCVD, PECVD and LECVD; screen printing) • Etching and Bulk Micromachining (definitions, wet chemical etching, isotropic etch with HNA, electrochemical etching, anisotropic etching with KOH/TMAH: theory, corner undercutting, measures for compensation and etch-stop techniques; plasma processes, dry etching: back sputtering, plasma etching, RIE, Bosch process, cryo process, XeF2 etching) • Surface Micromachining and alternative Techniques (sacrificial etching, film stress, stiction: theory and counter measures; Origami microstructures, Epi-Poly, porous silicon, SOI, SCREAM process, LIGA, SU8, rapid prototyping) • Thermal and Radiation Sensors (temperature measurement, self-generating sensors: Seebeck effect and thermopile; modulating sensors: thermo resistor, Pt-100, spreading resistance sensor, pn junction, NTC and PTC; thermal anemometer, mass flow sensor, photometry, radiometry, IR sensor: thermopile and bolometer) • Mechanical Sensors (strain based and stress based principle, capacitive readout, piezoresistivity, pressure sensor: piezoresistive, capacitive and fabrication process; accelerometer: piezoresistive, piezoelectric and capacitive; angular rate sensor: operating principle and fabrication process) • Magnetic Sensors (galvanomagnetic sensors: spinning current Hall sensor and magneto-transistor; magnetoresistive sensors: magneto resistance, AMR and GMR, fluxgate magnetometer) • Chemical and Bio Sensors (thermal gas sensors: pellistor and thermal conductivity sensor; metal oxide semiconductor gas sensor, organic semiconductor gas sensor, Lambda probe, MOSFET gas sensor, pH-FET, SAW sensor, principle of biosensor, Clark electrode, enzyme electrode, DNA chip) • Micro Actuators, Microfluidics and TAS (drives: thermal, electrostatic, piezo electric and electromagnetic; light modulators, DMD, adaptive optics, microscanner, microvalves: passive and active, micropumps, valveless micropump, electrokinetic micropumps, micromixer, filter, inkjet printhead, microdispenser, microfluidic switching elements, microreactor, lab-on-a-chip, microanalytics) • MEMS in medical Engineering (wireless energy and data transmission, smart pill, implantable drug delivery system, stimulators: microelectrodes, cochlear and retinal implant; implantable pressure sensors, intelligent osteosynthesis, implant for spinal cord regeneration) • Design, Simulation, Test (development and design flows, bottom-up approach, top-down approach, testability, modelling: multiphysics, FEM and equivalent circuit simulation; reliability test, physics-of-failure, Arrhenius equation, bath-tub relationship) • System Integration (monolithic and hybrid integration, assembly and packaging, dicing, electrical contact: wire bonding, TAB and flip chip bonding; packages, chip-on-board, wafer-level-package, 3D integration, wafer bonding: anodic bonding and silicon fusion bonding; micro electroplating, 3D-MID)
Literature	M. Madou: Fundamentals of Microfabrication, CRC Press, 2002 N. Schwesinger: Lehrbuch Mikrosystemtechnik, Oldenbourg Verlag, 2009 T. M. Adams, R. A. Layton:Introductory MEMS, Springer, 2010 G. Gerlach; W. Dötzel: Introduction to microsystem technology, Wiley, 2008

Course L0928: Productivity Management	
Typ	Project-/problem-based Learning
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. Hermann Lödding
Language	DE
Cycle	SoSe
Content	• Principles of productivity management • Shop floor management and standardisation • Takt analysis and design of manual operations • Maintenance Principles • Total Productive Maintenance (TPM) • Optimisation of set-up operations • Analysis of interlinked production systems
Literature	Bokranz, R.; Landau, K.:Produktivitätsmanagement von Arbeitssystemen. Schäffer-Poeschel, Stuttgart, 2006. Takeda, H.: Das synchrone Produktionssystem: Just-in-Time für das ganze Unternehmen. 5. Aufl., mi-Wirtschaftsbuch, FinanzBuch Verlag, München, 2006. Nakajima, S.: Management der Produktionseinrichtungen (Total Productive Maintenance). Campus Verlag, New York, 1995. Shingo, S.: A Revolution in Manufacturing: The SMED System. Productivity, Inc., 1985

Course L0931: Productivity Management	
Typ	Recitation Section (small)
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. Hermann Lödding
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0664: Feedback Control in Medical Technology	
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	20 min
Lecturer	Johannes Kreuzer, Christian Neuhaus
Language	DE
Cycle	SoSe
Content	Always viewed from the engineer's point of view, the lecture is structured as follows: • Introduction to the topic • Fundamentals of physiological modelling • Introduction to Breathing and Ventilation • Physiology and Pathology in Cardiology • Introduction to the Regulation of Blood Glucose • kidney function and renal replacement therapy • Representation of the control technology on the concrete ventilator • Excursion to a medical technology company Techniques of modeling, simulation and controller development are discussed. In the models, simple equivalent block diagrams for physiological processes are derived and explained how sensors, controllers and actuators are operated. MATLAB and SIMULINK are used as development tools.
Literature	• Leonhardt, S., & Walter, M. (2016). Medizintechnische Systeme. Berlin, Heidelberg: Springer Vieweg. • Werner, J. (2005). Kooperative und autonome Systeme der Medizintechnik. München: Oldenbourg. • Oczenski, W. (2017). Atmen : Atemhilfen ; Atemphysiologie und Beatmungstechnik: Georg Thieme Verlag KG.

Course L0313: Renewable Energy	
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. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	• introduction • solar energy for heat and power generation • wind power for electricity generation • hydropower for electricity generation • ocean energy for electricity generation • geothermal energy for heat and electricty generation
Literature	• Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage • Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg,2007

Course L1434: Renewable Energy	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and scale	60 Minuten
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	Students work on different tasks in the field of renewable energies. They present their solutions in the exercise lesson and discuss it with other students and the lecturer. Possible tasks in the field of renewable energies are: • Solar thermal heat • Concentrating solare power • Photovoltaic • Windenergie • Hydropower • Heat pump • Deep geothermal energy
Literature	• Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage • Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg,2007

Course L1130: Six Sigma	
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. Claus Emmelmann
Language	DE
Cycle	WiSe
Content	• Introduction and structuring • Basic terms of quality management • Measuring and inspection equipment • Tools of quality management: FMEA, QFD, FTA, etc. • Quality management methodology Six Sigma, DMAIC
Literature	Pfeifer, T.: Qualitätsmanagement : Strategien, Methoden, Techniken, 4. Aufl., München 2008 Pfeifer, T.: Praxishandbuch Qualitätsmanagement, München 1996 Geiger, W., Kotte, W.: Handbuch Qualität : Grundlagen und Elemente des Qualitätsmanagements: Systeme, Perspektiven, 5. Aufl., Wiesbaden 2008

Course L1820: System Simulation	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Stefan Wischhusen
Language	DE
Cycle	WiSe
Content	All participants must bring a notebook, to install and use the software OpenModelica. • Instruction and modelling of physical processes • Modelling and limits of model • Time constant, stiffness, stability, step size • Terms of object orientated programming • Differential equations of simple systems • Introduction into Modelica • Introduction into simulation tool • Example: Heat transfer • Example: System with different subsystems
Literature	[1] Modelica Association: "Modelica Language Specification - Version 3.3", Linköping, Sweden, 2 0 1 2 [2] M. Tiller: "Modelica by Example", http://book.xogeny.com, 2014. [3] M. Otter, H. Elmqvist, et al.: "Objektorientierte Modellierung Physikalischer Systeme", at- Automatisierungstechnik (german), Teil 1 - 17, Oldenbourg Verlag, 1999 - 2000. [4] P. Fritzson: "Principles of Object-Oriented Modeling and Simulation with Modelica 3.3", Wiley-IEEE Press, New York, 2015. [5] P. Fritzson: "Introduction to Modeling and Simulation of Technical and Physical Systems with Modelica", Wiley, New York, 2011.

Course L1821: System Simulation	
Typ	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and scale	30 min
Lecturer	Dr. Stefan Wischhusen
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1513: Technical Design	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	10-15 Entwurfszeichnungen, Skizzen und ca. 5-10 A4-Dokumentationsseiten (Themen- und Entwurfsbegründung)
Lecturer	Prof. Werner Granzeier
Language	DE
Cycle	SoSe
Content	• Basics with analysis, concept, proposal drawings and sketches • Samples from practice of technical industrial design • Product concept with new ideas and package • ID proposal with structural concept and external product ergonomics • Visualisation and presentation of the overall concept • Realization as individual case studies
Literature	Literatur über technisches Produktdesign Technisches Rendering und Präsentation

Zeichnen und perspektivisches Entwerfen

Literaturhinweise

What is Product Design ?

Laura Slack

RotoVision Schweiz 2006

Product Design Now

Design and Scetches

CollinsDesign and maomao publications Spanien 2006

Ronald B. Kemnitzer, Rendering With Markers - Definitive Techniques

for Designers, Illustrators and Architects,

Watson, Guptil Puplications,a division of Billboard Publications Inc.,

New York 1983

Creative Techniques

DRAWING

Barons Educational Series

ISBN-13: 978-0-7641-6182-7

Joseph Ungar, Rendering In Mixed Media - Techniques for Concept

Presentation for Designers and Illustrators

Watson-Guptil Publication a division of Billboard Publications Inc.,

New York 1985

AIRWORLD

Design und Architektur für die Flugreise

Vitra Design Stiftung Weil am Rhein 2004

Airline Design

Perter Deslius Jacek Slaski te Neues 2005

Technik und Sicherheit von Passagierflugzeugen

Frank Littek

Motorbuch Verlag 2003

Jetliner Cabins

Jennifer Coutts Clay

Cs books England 2006

BOEING Widebodies

Michael Haenggi motorbooks international USA 2003

form - Zeitschrift für Gestaltung, Verlag form GmbH,

Hofgut Ober-Berrbach, 6104 Seeheim-Jugenheim

(erscheint vierteljährlich, Verlag form GmbH)

design report

german magasin,

(erscheint monatlich)

md - möbel interior design, Konradin-Verlag

Robert Kohlhammer GmbH, 7022 Leinfelden-Echterdingen

(erscheint monatlich)

CAR STYLING, Car Styling Publishing Co. 4-8-16-11F,

Kitashinjuku, Shinjuku-ku, Tokio 160, Japan

(erscheint vierteljährlich in japanischer und englischer Sprache, in Hamburg erhältlich bei: Overseas Courier Service Deutschland GmbH,

Auto & Design,

Corso Frabcia 161, 10139 Torino, Italia

	(erscheint vierteljährlich in italienischer und englischer Sprache alle zwei Monate , erhältlich am HBF Hamburg AERO International, Magazin für Zivilluftfahrt (erscheint monatlich) Aircraft interior international Engl. magasin for Aircraft cabin interior (erscheint 2 monatlich) aerotec Technik- und Branchenmagazin für die Luft- und Raumfahrtindustrie

Course L0379: Ceramics Technology	
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	Dr. Rolf Janßen
Language	DE/EN
Cycle	WiSe
Content	Introduction to ceramic processing with emphasis on advanced structural ceramics. The course focus predominatly on powder-based processing, e.g. “powder-metauurgical techniques and sintering (soild state and liquid phase). Also, some aspects of glass and cement science as well as new developments in powderless forming techniques of ceramics and ceramic composites will be addressed Examples will be discussed in order to give engineering students an understanding of technology development and specific applications of ceramic components. **Content:** 1. Introduction Inhalt: 2. Raw materials 3. Powder fabrication 4. Powder processing 5. Shape-forming processes 6. Densification, sintering 7. Glass and Cement technology 8. Ceramic-metal joining techniques
Literature	W.D. Kingery, „Introduction to Ceramics“, John Wiley & Sons, New York, 1975 ASM Engineering Materials Handbook Vol.4 „Ceramics and Glasses“, 1991 D.W. Richerson, „Modern Ceramic Engineering“, Marcel Decker, New York, 1992 Skript zur Vorlesung

Course L0949: Materials Testing	
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	Dr. Jan Oke Peters
Language	DE
Cycle	WiSe
Content	Application and analysis of basic mechanical as well as non-destructive testing of materials • Determination elastic constants • Tensile test • Fatigue test (testing with constant stress, strain, or plastiv strain amplitude, low and high cycle fatigue, mean stress effect) • Crack growth upon static loading (stress intensity factor, fracture toughness) • Creep test • Hardness test • Charpy impact test • Non destructive testing
Literature	E. Macherauch: Praktikum in Werkstoffkunde, Vieweg G. E. Dieter: Mechanical Metallurgy, McGraw-Hill

Course L0176: Reliability in Engineering Dynamics	
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 min.
Lecturer	Prof. Uwe Weltin
Language	EN
Cycle	SoSe
Content	Method for calculation and testing of reliability of dynamic machine systems • Modeling • System identification • Simulation • Processing of measurement data • Damage accumulation • Test planning and execution
Literature	Bertsche, B.: Reliability in Automotive and Mechanical Engineering. Springer, 2008. ISBN: 978-3-540-33969-4 Inman, Daniel J.: Engineering Vibration. Prentice Hall, 3rd Ed., 2007. ISBN-13: 978-0132281737 Dresig, H., Holzweißig, F.: Maschinendynamik, Springer Verlag, 9. Auflage, 2009. ISBN 3540876936. VDA (Hg.): Zuverlässigkeitssicherung bei Automobilherstellern und Lieferanten. Band 3 Teil 2, 3. überarbeitete Auflage, 2004. ISSN 0943-9412

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

Course L0749: Reliability of Aircraft Systems	
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. Frank Thielecke, Dr. Andreas Vahl, Dr. Uwe Wieczorek
Language	DE
Cycle	WiSe
Content	• Functions of reliability and safety (regulations, certification requirements) • Basics methods of reliability analysis (FMEA, fault tree, functional hazard assessment) • Reliability analysis of electrical and mechanical systems
Literature	• CS 25.1309 • SAE ARP 4754 • SAE ARP 4761

Module M1193: Cabin Systems Engineering

Courses

Title	Typ	Hrs/wk	CP
Computer and communication technology in cabin electronics and avionics (L1557)	Lecture	2	2
Computer and communication technology in cabin electronics and avionics (L1558)	Recitation Section (small)	1	1
Model-Based Systems Engineering (MBSE) with SysML/UML (L1551)	Project-/problem-based Learning	3	3

Module Responsible	Prof. Ralf God
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Electrical Engineering • Control Systems Previous knowledge in: • Systems Engineering
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to: • describe the structure and operation of computer architectures • explain the structure and operation of digital communication Networks • explain architectures of cabin electronics, integrated modular avionics (IMA) and Aircraft Data Communication Network (ADCN) • understand the approach of Model-Based Systems Engineering (MBSE) in the design of hardware and software-based cabin systems
Skills	Students are able to: • understand, operate and maintain a Minicomputer • build up a network communication and communicate with other network participants • connect a minicomputer with a cabin management system (A380 CIDS) and communicate over a AFDX®-Network • model system functions by means of formal languages SysML/UML and generate software code from the models • execute software code on a minicomputer
Personal Competence	
Social Competence	Students are able to: • elaborate partial results and merge with others to form a complete solution
Autonomy	Students are able to: • organize and schedule their practical tasks
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 minutes
Assignment for the Following Curricula	Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Air Transportation Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Cabin Systems: Compulsory International Management and Engineering: Specialisation II. Aviation Systems: 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory

Course L1557: Computer and communication technology in cabin electronics and avionics	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf God
Language	DE
Cycle	WiSe
Content	The objective of the lecture with the corresponding exercise is the acquisition of knowledge of computer and communication technology in electronic systems in the cabin and in aircraft. For the system engineer the strong interaction of software, mechanical and electronic system components nowadays requires a basic understanding of cabin electronics and avionics. The course teaches the basics of design and functionality of computers and data networks. Subsequently it focuses on current principles and applications in integrated modular avionics (IMA), aircraft data communication networks (ADCN), cabin electronics and cabin networks: • History of computer and network technology • Layer model in computer technology • Computer architectures (PC, IPC, Embedded Systems) • BIOS, UEFI and operating system (OS) • Programming languages (machine code and high-level languages) • Applications and Application Programming Interfaces • External interfaces (serial, USB, Ethernet) • Layer model in network technology • Network topologies • Network components • Bus access procedures • Integrated Modular Avionics (IMA) and Aircraft Data Communication Networks (ADCN) • Cabin electronics and cabin networks
Literature	- Skript zur Vorlesung - Schnabel, P.: Computertechnik-Fibel: Grundlagen Computertechnik, Mikroprozessortechnik, Halbleiterspeicher, Schnittstellen und Peripherie. Books on Demand; 1. Auflage, 2003 - Schnabel, P.: Netzwerktechnik-Fibel: Grundlagen, Übertragungstechnik und Protokolle, Anwendungen und Dienste, Sicherheit. Books on Demand; 1. Auflage, 2004 - Wüst, K.: Mikroprozessortechnik: Grundlagen, Architekturen und Programmierung von Mikroprozessoren, Mikrocontrollern und Signalprozessoren. Vieweg Verlag; 2. aktualisierte und erweiterte Auflage, 2006

Course L1558: Computer and communication technology in cabin electronics and avionics	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Ralf God
Language	DE
Cycle	WiSe
Content	The objective of the lecture with the corresponding exercise is the acquisition of knowledge of computer and communication technology in electronic systems in the cabin and in aircraft. For the system engineer the strong interaction of software, mechanical and electronic system components nowadays requires a basic understanding of cabin electronics and avionics. The course teaches the basics of design and functionality of computers and data networks. Subsequently it focuses on current principles and applications in integrated modular avionics (IMA), aircraft data communication networks (ADCN), cabin electronics and cabin networks: • History of computer and network technology • Layer model in computer technology • Computer architectures (PC, IPC, Embedded Systems) • BIOS, UEFI and operating system (OS) • Programming languages (machine code and high-level languages) • Applications and Application Programming Interfaces • External interfaces (serial, USB, Ethernet) • Layer model in network technology • Network topologies • Network components • Bus access procedures • Integrated Modular Avionics (IMA) and Aircraft Data Communication Networks (ADCN) • Cabin electronics and cabin networks
Literature	- Skript zur Vorlesung - Schnabel, P.: Computertechnik-Fibel: Grundlagen Computertechnik, Mikroprozessortechnik, Halbleiterspeicher, Schnittstellen und Peripherie. Books on Demand; 1. Auflage, 2003 - Schnabel, P.: Netzwerktechnik-Fibel: Grundlagen, Übertragungstechnik und Protokolle, Anwendungen und Dienste, Sicherheit. Books on Demand; 1. Auflage, 2004 - Wüst, K.: Mikroprozessortechnik: Grundlagen, Architekturen und Programmierung von Mikroprozessoren, Mikrocontrollern und Signalprozessoren. Vieweg Verlag; 2. aktualisierte und erweiterte Auflage, 2006

Course L1551: Model-Based Systems Engineering (MBSE) with SysML/UML	
Typ	Project-/problem-based Learning
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Ralf God, Dr. Sylvia Melzer
Language	DE
Cycle	SoSe
Content	Objectives of the problem-oriented course are the acquisition of knowledge on system design using the formal languages SysML/UML, learning about tools for modeling and finally the implementation of a project with methods and tools of Model-Based Systems Engineering (MBSE) on a realistic hardware platform (e.g. Arduino®, Raspberry Pi®): • What is a model? • What is Systems Engineering? • Survey of MBSE methodologies • The modelling languages SysML /UML • Tools for MBSE • Best practices for MBSE • Requirements specification, functional architecture, specification of a solution • From model to software code • Validation and verification: XiL methods • Accompanying MBSE project
Literature	- Skript zur Vorlesung - Weilkiens, T.: Systems Engineering mit SysML/UML: Modellierung, Analyse, Design. 2. Auflage, dpunkt.Verlag, 2008 - Holt, J., Perry, S.A., Brownsword, M.: Model-Based Requirements Engineering. Institution Engineering & Tech, 2011

Module M0511: Electricity Generation from Wind and Hydro Power

Courses

Title	Typ	Hrs/wk	CP
Renewable Energy Projects in Emerged Markets (L0014)	Project Seminar	1	1
Hydro Power Use (L0013)	Lecture	1	1
Wind Turbine Plants (L0011)	Lecture	2	3
Wind Energy Use - Focus Offshore (L0012)	Lecture	1	1

Module Responsible	Dr. Joachim Gerth
Admission Requirements	None
Recommended Previous Knowledge	Module: Technical Thermodynamics I, Module: Technical Thermodynamics II, Module: Fundamentals of Fluid Mechanics
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	By ending this module students can explain in detail knowledge of wind turbines with a particular focus of wind energy use in offshore conditions and can critical comment these aspects in consideration of current developments. Furthermore, they are able to describe fundamentally the use of water power to generate electricity. The students reproduce and explain the basic procedure in the implementation of renewable energy projects in countries outside Europe. Through active discussions of various topics within the seminar of the module, students improve their understanding and the application of the theoretical background and are thus able to transfer what they have learned in practice.
Skills	Students are able to apply the acquired theoretical foundations on exemplary water or wind power systems and evaluate and assess technically the resulting relationships in the context of dimensioning and operation of these energy systems. They can in compare critically the special procedure for the implementation of renewable energy projects in countries outside Europe with the in principle applied approach in Europe and can apply this procedure on exemplary theoretical projects.
Personal Competence	
Social Competence	Students can discuss scientific tasks subjet-specificly and multidisciplinary within a seminar.
Autonomy	Students can independently exploit sources in the context of the emphasis of the lecture material to clear the contents of the lecture and to acquire the particular knowledge about the subject area.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	3 hours written exam
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Energy and Environmental Engineering: Specialisation Energy Engineering: Elective Compulsory International Management and Engineering: Specialisation II. Renewable Energy: Elective Compulsory International Management and Engineering: Specialisation II. Energy and Environmental Engineering: 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 Renewable Energies: Core Qualification: Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory Water and Environmental Engineering: Specialisation Environment: Compulsory Water and Environmental Engineering: Specialisation Cities: Elective Compulsory

Course L0014: Renewable Energy Projects in Emerged Markets	
Typ	Project Seminar
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Andreas Wiese
Language	DE
Cycle	SoSe
Content	1. Introduction ◦ Development of renewable energies worldwide ▪ History ▪ Future markets ◦ Special challenges in new markets - Overview 2. Sample project wind farm Korea ◦ Survey ◦ Technical Description ◦ Project phases and characteristics 3. Funding and financing instruments for EE projects in new markets ◦ Overview funding opportunitie ◦ Overview countries with feed-in laws ◦ Major funding programs 4. CDM projects - why, how , examples ◦ Overview CDM process ◦ Examples ◦ Exercise CDM 5. Rural electrification and hybrid systems - an important future market for EE ◦ Rural Electrification - Introduction ◦ Types of Elektrizifierungsprojekten ◦ The role of the EEInterpretation of hybrid systems ◦ Project example: hybrid system Galapagos Islands 6. Tendering process for EE projects - examples ◦ South Africa ◦ Brazil 7. Selected projects from the perspective of a development bank - Wesley Urena Vargas, KfW Development Bank ◦ Geothermal ◦ Wind or CSP Within the seminar, the various topics are actively discussed and applied to various cases of application.
Literature	Folien der Vorlesung

Course L0013: Hydro Power Use	
Typ	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Stefan Achleitner
Language	DE
Cycle	SoSe
Content	• Introduction, importance of water power in the national and global context • Physical basics: Bernoulli's equation, usable height of fall, hydrological measures, loss mechanisms, efficiencies • Classification of Hydropower: Flow and Storage hydropower, low and high pressure systems • Construction of hydroelectric power plants: description of the individual components and their technical system interaction • Structural engineering components; representation of dams, weirs, dams, power houses, computer systems, etc. • Energy Technical Components: Illustration of the different types of hydraulic machinery, generators and grid connection • Hydropower and the Environment • Examples from practice
Literature	• Schröder, W.; Euler, G.; Schneider, K.: Grundlagen des Wasserbaus; Werner, Düsseldorf, 1999, 4. Auflage • Quaschning, V.: Regenerative Energiesysteme: Technologie - Berechnung - Simulation; Carl Hanser, München, 2011, 7. Auflage • Giesecke, J.; Heimerl, S.; Mosony, E.: Wasserkraftanlagen - Planung, Bau und Betrieb; Springer, Berlin, Heidelberg, 2009, 5. Auflage • von König, F.; Jehle, C.: Bau von Wasserkraftanlagen - Praxisbezogene Planungsunterlagen; C. F. Müller, Heidelberg, 2005, 4. Auflage • Strobl, T.; Zunic, F.: Wasserbau: Aktuelle Grundlagen - Neue Entwicklungen; Springer, Berlin, Heidelberg, 2006

Course L0011: Wind Turbine Plants	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Rudolf Zellermann, Dr. Jochen Oexmann
Language	DE
Cycle	SoSe
Content	• Historical development • Wind: origins, geographic and temporal distribution, locations • Power coefficient, rotor thrust • Aerodynamics of the rotor • Operating performance • Power limitation, partial load, pitch and stall control • Plant selection, yield prediction, economy • Excursion
Literature	Gasch, R., Windkraftanlagen, 4. Auflage, Teubner-Verlag, 2005

Course L0012: Wind Energy Use - Focus Offshore	
Typ	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Martin Skiba
Language	DE
Cycle	SoSe
Content	• Introduction, importance of offshore wind power generation, Specific requirements for offshore engineering • Physical fundamentals for utilization of wind energy • Design and operation of offshore wind turbines, presentation of different concepts of offshore wind turbines, representation of the individual system components and their system-technical relationships • Foundation engineering, offshore site investigation, presentation of different concepts of offshore foundation structures, planning and fabrication of foundation structures • Electrical infrastructure of an offshore wind farm, Inner Park cabling, offshore substation, grid connection • Installation of offshore wind farms, installation techniques and auxiliary devices, construction logistics • Development and planning of offshore wind farms • Operation and optimization of offshore wind farms • Day excursion
Literature	• Gasch, R.; Twele, J.: Windkraftanlagen - Grundlagen, Entwurf, Planung und Betrieb; Vieweg + Teubner, Stuttgart, 2007, 7. Auflage • Molly, J. P.: Windenergie - Theorie, Anwendung, Messung; C. F. Müller, Heidel-berg, 1997, 3. Auflage • Hau, E.: Windkraftanalagen; Springer, Berlin, Heidelberg, 2008, 4.Auflage • Heier, S.: Windkraftanlagen - Systemauslegung, Integration und Regelung; Vieweg + Teubner, Stuttgart, 2009, 5. Auflage • Jarass, L.; Obermair, G.M.; Voigt, W.: Windenergie: Zuverlässige Integration in die Energieversorgung; Springer, Berlin, Heidelberg, 2009, 2. Auflage

Module M0630: Robotics and Navigation in Medicine

Courses

Title	Typ	Hrs/wk	CP
Robotics and Navigation in Medicine (L0335)	Lecture	2	3
Robotics and Navigation in Medicine (L0338)	Project Seminar	2	2
Robotics and Navigation in Medicine (L0336)	Recitation Section (small)	1	1

Module Responsible	Prof. Alexander Schlaefer
Admission Requirements	None
Recommended Previous Knowledge	• principles of math (algebra, analysis/calculus) • principles of programming, e.g., in Java or C++ • solid R or Matlab skills
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students can explain kinematics and tracking systems in clinical contexts and illustrate systems and their components in detail. Systems can be evaluated with respect to collision detection and safety and regulations. Students can assess typical systems regarding design and limitations.
Skills	The students are able to design and evaluate navigation systems and robotic systems for medical applications.
Personal Competence	
Social Competence	The students discuss the results of other groups, provide helpful feedback and can incoorporate feedback into their work.
Autonomy	The students can reflect their knowledge and document the results of their work. They can present the results in an appropriate manner.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	**Compulsory** / **Bonus** / **Form** / **Description** Yes / 10 % / Written elaboration Yes / 10 % / Presentation
Examination	Written exam
Examination duration and scale	90 minutes
Assignment for the Following Curricula	Computer Science: Specialisation Intelligence Engineering: Elective Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory International Management and Engineering: Specialisation II. Electrical Engineering: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: 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 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Bio- and Medical Technology: Elective Compulsory

Course L0335: Robotics and Navigation in Medicine

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Alexander Schlaefer
Language	EN
Cycle	SoSe
Content	- kinematics - calibration - tracking systems - navigation and image guidance - motion compensation The seminar extends and complements the contents of the lecture with respect to recent research results.
Literature	Spong et al.: Robot Modeling and Control, 2005 Troccaz: Medical Robotics, 2012 Further literature will be given in the lecture.

Course L0338: Robotics and Navigation in Medicine	
Typ	Project Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Alexander Schlaefer
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0336: Robotics and Navigation in Medicine	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Alexander Schlaefer
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0764: Aircraft Systems II

Courses

Title	Typ	Hrs/wk	CP
Aircraft Systems II (L0736)	Lecture	3	4
Aircraft Systems II (L0740)	Recitation Section (large)	2	2

Module Responsible	Prof. Frank Thielecke
Admission Requirements	None
Recommended Previous Knowledge	basic knowledge of: • mathematics • mechanics • thermo dynamics • electronics • fluid technology • control technology
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to... • describe the structure of primary flight control systems as well as actuation-, avionic-, fuel- and landing gear-systems in general along with corresponding properties and applications. • explain different configurations and designs and their origins • explain atmospheric conditions for icing such as the functionality of anti-ice systems
Skills	Students are able to... • size primary flight control actuation systems • perform a controller design process for the flight control actuators • design high-lift kinematics • design and analyse landing gear systems • design anti-ice systems
Personal Competence	
Social Competence	Students are able to: • Develop joint solutions in mixed teams
Autonomy	Students are able to: • derive requirements and perform appropriate yet simplified design processes for aircraft systems from complex issues and circumstances in a self-reliant manner
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	165 Minutes
Assignment for the Following Curricula	Aircraft Systems Engineering: Core Qualification: Compulsory International Management and Engineering: Specialisation II. Aviation Systems: 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory

Course L0736: Aircraft Systems II	
Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	SoSe
Content	• Actuation (Principles of actuators; electro-mechanical actuators; modeling, analysis and sizing of position control systems; hydro-mechanic actuation systems) • Flight Control Systems (control surfaces, hinge moments; requirements of stability and controllability, actuation power; principles of reversible and irreversible flight control systems; servo actuation systems) • Landing Gear Systems (Configurations and geometries; analysis of landing gear systems with respect to damper dynamics, dynamics of the breaking aircraft and power consumption; design and analysis of breaking systems with respect to energy and heat; anti-skit systems) • Fuel Systems (Architectures; aviation fuels; system components; fueling system; tank inerting system; fuel management; trim tank) • De- and Anti-Ice Systems: (Atmospheric icing conditions; principles of de- and anti-ice systems)
Literature	• Moir, Seabridge: Aircraft Systems • Torenbek: Synthesis of Subsonic Airplane Design • Curry: Aircraft Landing Gear Design: Principles and Practices

Course L0740: Aircraft Systems II	
Typ	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0811: Medical Imaging Systems

Courses

Title	Typ	Hrs/wk	CP
Medical Imaging Systems (L0819)	Lecture	4	6

Module Responsible	Dr. Michael Grass
Admission Requirements	None
Recommended Previous Knowledge	none
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can: • Describe the system configuration and components of the main clinical imaging systems; • Explain how the system components and the overall system of the imaging systems function; • Explain and apply the physical processes that make imaging possible and use with the fundamental physical equations; • Name and describe the physical effects required to generate image contrasts; • Explain how spatial and temporal resolution can be influenced and how to characterize the images generated; • Explain which image reconstruction methods are used to generate images; Describe and explain the main clinical uses of the different systems.

Skills	Students are able to:
	• Explain the physical processes of images and assign to the systems the basic mathematical or physical equations required;
	  ◦ Calculate the parameters of imaging systems using the mathematical or physical equations;
	  ◦ Determine the influence of different system components on the spatial and temporal resolution of imaging systems;
	  ◦ Explain the importance of different imaging systems for a number of clinical applications;
	Select a suitable imaging system for an application.

Personal Competence	
Social Competence	none
Autonomy	Students can: • Understand which physical effects are used in medical imaging; • Decide independently for which clinical issue a measuring system can be used.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Biomedical Engineering: 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Bio- and Medical Technology: Elective Compulsory

Course L0819: Medical Imaging Systems

Typ	Lecture
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Dr. Michael Grass, Dr. Tim Nielsen, Dr. Sven Prevrhal, Frank Michael Weber
Language	DE
Cycle	SoSe
Content	
Literature	Primary book: 1. P. Suetens, "Fundamentals of Medical Imaging", Cambridge Press Secondary books: - A. Webb, "Introduction to Biomedical Imaging", IEEE Press 2003. - W.R. Hendee and E.R. Ritenour, "Medical Imaging Physics", Wiley-Liss, New York, 2002. - H. Morneburg (Edt), "Bildgebende Systeme für die medizinische Diagnostik", Erlangen: Siemens Publicis MCD Verlag, 1995. - O. Dössel, "Bildgebende Verfahren in der Medizin", Springer Verlag Berlin, 2000.

Module M1156: Systems Engineering

Courses

Title	Typ	Hrs/wk	CP
Systems Engineering (L1547)	Lecture	3	4
Systems Engineering (L1548)	Recitation Section (large)	1	2

Module Responsible	Prof. Ralf God
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Electrical Engineering • Control Systems Previous knowledge in: • Aircraft Cabin Systems
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to: • understand systems engineering process models, methods and tools for the development of complex Systems • describe innovation processes and the need for technology Management • explain the aircraft development process and the process of type certification for aircraft • explain the system development process, including requirements for systems reliability • identify environmental conditions and test procedures for airborne Equipment • value the methodology of requirements-based engineering (RBE) and model-based requirements engineering (MBRE)
Skills	Students are able to: • plan the process for the development of complex Systems • organize the development phases and development Tasks • assign required business activities and technical Tasks • apply systems engineering methods and tools
Personal Competence	
Social Competence	Students are able to: • understand their responsibilities within a development team and integrate themselves with their role in the overall process
Autonomy	Students are able to: • interact and communicate in a development team which has distributed tasks
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 Minutes
Assignment for the Following Curricula	Aircraft Systems Engineering: Core Qualification: Compulsory International Management and Engineering: Specialisation II. Aviation Systems: Elective Compulsory International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Aircraft Systems Engineering: Elective Compulsory

Course L1547: Systems Engineering	
Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Ralf God
Language	DE
Cycle	SoSe
Content	The objective of the lecture with the corresponding exercise is to accomplish the prerequisites for the development and integration of complex systems using the example of commercial aircraft and cabin systems. Competences in the systems engineering process, tools and methods is to be achieved. Regulations, guidelines and certification issues will be known. Key aspects of the course are processes for innovation and technology management, system design, system integration and certification as well as tools and methods for systems engineering: • Innovation processes • IP-protection • Technology management • Systems engineering • Aircraft program • Certification issues • Systems development • Safety objectives and fault tolerance • Environmental and operating conditions • Tools for systems engineering • Requirements-based engineering (RBE) • Model-based requirements engineering (MBRE)
Literature	- Skript zur Vorlesung - diverse Normen und Richtlinien (EASA, FAA, RTCA, SAE) - Hauschildt, J., Salomo, S.: Innovationsmanagement. Vahlen, 5. Auflage, 2010 - NASA Systems Engineering Handbook, National Aeronautics and Space Administration, 2007 - Hinsch, M.: Industrielles Luftfahrtmanagement: Technik und Organisation luftfahrttechnischer Betriebe. Springer, 2010 - De Florio, P.: Airworthiness: An Introduction to Aircraft Certification. Elsevier Ltd., 2010 - Pohl, K.: Requirements Engineering. Grundlagen, Prinzipien, Techniken. 2. korrigierte Auflage, dpunkt.Verlag, 2008

Course L1548: Systems Engineering	
Typ	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Ralf God
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1161: Turbomachinery

Courses			
Title	**Typ**	**Hrs/wk**	**CP**
Turbomachines (L1562)	Lecture	3	4
Turbomachines (L1563)	Recitation Section (large)	1	2

Module Responsible	Prof. Franz Joos
Admission Requirements	None
Recommended Previous Knowledge	Technical Thermodynamics I, II, Fluid Dynamics, Heat Transfer
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students can • distinguish the physical phenomena of conversion of energy, • understand the different mathematic modelling of turbomachinery, • calculate and evaluate turbomachinery.
Skills	The students are able to - understand the physics of Turbomachinery, - solve excersises self-consistent.
Personal Competence	
Social Competence	The students are able to • discuss in small groups and develop an approach.
Autonomy	The students are able to • develop a complex problem self-consistent, • analyse the results in a critical way, • have an qualified exchange with other students.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Energy Systems: Specialisation Marine Engineering: Elective Compulsory Energy Systems: Specialisation Energy Systems: 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory

Course L1562: Turbomachines

Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Markus Schatz, Prof. Dr. Karsten Meier
Language	DE
Cycle	SoSe
Content	Topics to be covered will include: • Application cases of turbomachinery • Fundamentals of thermodynamics and fluid mechanics • Design fundamentals of turbomachinery • Introduction to the theory of turbine stage • Design and operation of the turbocompressor • Design and operation of the steam turbine • Design and operation of the gas turbine • Physical limits of the turbomachines
Literature	• Traupel: Thermische Turbomaschinen, Springer. Berlin, Heidelberg, New York • Bräunling: Flugzeuggasturbinen, Springer., Berlin, Heidelberg, New York • Seume: Stationäre Gasturbinen, Springer., Berlin, Heidelberg, New York • Menny: Strömungsmaschinen, Teubner., Stuttgart

Course L1563: Turbomachines	
Typ	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Markus Schatz, Prof. Dr. Karsten Meier
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1170: Phenomena and Methods in Materials Science

Courses			
Title	**Typ**	**Hrs/wk**	**CP**
Experimental Methods for the Characterization of Materials (L1580)	Lecture	2	3
Phase equilibria and transformations (L1579)	Lecture	2	3

Module Responsible	Prof. Patrick Huber
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge in Materials Science, e.g. Werkstoffwissenschaft I/II
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	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.
Skills	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.
Personal Competence	
Social Competence	The students are able to present solutions to specialists and to develop ideas further.
Autonomy	The students are able to ... • assess their own strengths and weaknesses. • gather new necessary expertise by their own.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	International Management and Engineering: Specialisation II. Product Development and Production: 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 Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Materials Science: Elective Compulsory

Course L1580: Experimental Methods for the Characterization of Materials

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Patrick Huber
Language	DE
Cycle	SoSe
Content	• Structural characterization by photons, neutrons and electrons (in particular X-ray and neutron scattering, electron microscopy, tomography) • Mechanical and thermodynamical characterization methods (indenter measurements, mechanical compression and tension tests, specific heat measurements) • Characterization of optical, electrical and magnetic properties (spectroscopy, electrical conductivity and magnetometry)
Literature	William D. Callister und David G. Rethwisch, Materialwissenschaften und Werkstofftechnik, Wiley&Sons, Asia (2011). William D. Callister, Materials Science and Technology, Wiley& Sons, Inc. (2007).

Course L1579: Phase equilibria and transformations	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Jörg Weißmüller
Language	DE
Cycle	SoSe
Content	Fundamentals of statistical physics, formal structure of phenomenological thermodynamics, simple atomistic models and free-energy functions of solid solutions and compounds. Corrections due to nonlocal interaction (elasticity, gradient terms). Phase equilibria and alloy phase diagrams as consequence thereof. Simple atomistic considerations for interaction energies in metallic solid solutions. Diffusion in real systems. Kinetics of phase transformations for real-life boundary conditions. Partitioning, stability and morphology at solidification fronts. Order of phase transformations; glass transition. Phase transitions in nano- and microscale systems.
Literature	Wird im Rahmen der Lehrveranstaltung bekannt gegeben.

Module M1226: Mechanical Properties

Courses

Title	Typ	Hrs/wk	CP
Mechanical Behaviour of Brittle Materials (L1661)	Lecture	2	3
Dislocation Theory of Plasticity (L1662)	Lecture	2	3

Module Responsible	Dr. Erica Lilleodden
Admission Requirements	None
Recommended Previous Knowledge	Basics in Materials Science I/II
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can explain basic principles of crystallography, statics (free body diagrams, tractions) and thermodynamics (energy minimization, energy barriers, entropy)
Skills	Students are capable of using standardized calculation methods: tensor calculations, derivatives, integrals, tensor transformations
Personal Competence	
Social Competence	Students can provide appropriate feedback and handle feedback on their own performance constructively.
Autonomy	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
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Materials Science: Core Qualification: Compulsory Mechanical Engineering and Management: Specialisation Materials: 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: Compulsory Theoretical Mechanical Engineering: Specialisation Materials Science: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

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

Course L1662: Dislocation Theory of Plasticity	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Erica Lilleodden
Language	DE/EN
Cycle	SoSe
Content	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. 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.
Literature	Vorlesungsskript Aktuelle Publikationen Bücher: Introduction to Dislocations, by D. Hull and D.J. Bacon Theory of Dislocations, by J.P. Hirth and J. Lothe Physical Metallurgy, by Peter Hassen

Module M0840: Optimal and Robust Control

Courses

Title	Typ	Hrs/wk	CP
Optimal and Robust Control (L0658)	Lecture	2	3
Optimal and Robust Control (L0659)	Recitation Section (small)	2	3

Module Responsible	Prof. Herbert Werner
Admission Requirements	None
Recommended Previous Knowledge	• Classical control (frequency response, root locus) • State space methods • Linear algebra, singular value decomposition
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students can explain the significance of the matrix Riccati equation for the solution of LQ problems. • They can explain the duality between optimal state feedback and optimal state estimation. • They can explain how the H2 and H-infinity norms are used to represent stability and performance constraints. • They can explain how an LQG design problem can be formulated as special case of an H2 design problem. • They can explain how model uncertainty can be represented in a way that lends itself to robust controller design • They can explain how - based on the small gain theorem - a robust controller can guarantee stability and performance for an uncertain plant. • They understand how analysis and synthesis conditions on feedback loops can be represented as linear matrix inequalities.
Skills	• Students are capable of designing and tuning LQG controllers for multivariable plant models. • They are capable of representing a H2 or H-infinity design problem in the form of a generalized plant, and of using standard software tools for solving it. • They are capable of translating time and frequency domain specifications for control loops into constraints on closed-loop sensitivity functions, and of carrying out a mixed-sensitivity design. • They are capable of constructing an LFT uncertainty model for an uncertain system, and of designing a mixed-objective robust controller. • They are capable of formulating analysis and synthesis conditions as linear matrix inequalities (LMI), and of using standard LMI-solvers for solving them. • They can carry out all of the above using standard software tools (Matlab robust control toolbox).
Personal Competence	
Social Competence	Students can work in small groups on specific problems to arrive at joint solutions.
Autonomy	Students are able to find required information in sources provided (lecture notes, literature, software documentation) and use it to solve given problems.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Oral exam
Examination duration and scale	30 min
Assignment for the Following Curricula	Computer Science: Specialisation Intelligence Engineering: Elective Compulsory Electrical Engineering: Specialisation Control and Power Systems Engineering: Elective Compulsory Energy Systems: Core Qualification: Elective Compulsory Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory Mechatronics: Specialisation System Design: 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 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Core Qualification: Elective Compulsory

Course L0658: Optimal and Robust Control	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	EN
Cycle	SoSe
Content	• Optimal regulator problem with finite time horizon, Riccati differential equation • Time-varying and steady state solutions, algebraic Riccati equation, Hamiltonian system • Kalman’s identity, phase margin of LQR controllers, spectral factorization • Optimal state estimation, Kalman filter, LQG control • Generalized plant, review of LQG control • Signal and system norms, computing H2 and H∞ norms • Singular value plots, input and output directions • Mixed sensitivity design, H∞ loop shaping, choice of weighting filters • Case study: design example flight control • Linear matrix inequalities, design specifications as LMI constraints (H2, H∞ and pole region) • Controller synthesis by solving LMI problems, multi-objective design • Robust control of uncertain systems, small gain theorem, representation of parameter uncertainty
Literature	• Werner, H., Lecture Notes: "Optimale und Robuste Regelung" • Boyd, S., L. El Ghaoui, E. Feron and V. Balakrishnan "Linear Matrix Inequalities in Systems and Control", SIAM, Philadelphia, PA, 1994 • Skogestad, S. and I. Postlewhaite "Multivariable Feedback Control", John Wiley, Chichester, England, 1996 • Strang, G. "Linear Algebra and its Applications", Harcourt Brace Jovanovic, Orlando, FA, 1988 • Zhou, K. and J. Doyle "Essentials of Robust Control", Prentice Hall International, Upper Saddle River, NJ, 1998

Course L0659: Optimal and Robust Control	
Typ	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1343: Fibre-polymer-composites

Courses

Title	Typ	Hrs/wk	CP
Structure and properties of fibre-polymer-composites (L1894)	Lecture	2	3
Design with fibre-polymer-composites (L1893)	Lecture	2	3

Module Responsible	Prof. Bodo Fiedler
Admission Requirements	None
Recommended Previous Knowledge	Basics: chemistry / physics / materials science
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can use the knowledge of fiber-reinforced composites (FRP) and its constituents to play (fiber / matrix) and define the necessary testing and analysis. They can explain the complex relationships structure-property relationship and the interactions of chemical structure of the polymers, their processing with the different fiber types, including to explain neighboring contexts (e.g. sustainability, environmental protection).
Skills	Students are capable of • using standardized calculation methods in a given context to mechanical properties (modulus, strength) to calculate and evaluate the different materials. • approximate sizing using the network theory of the structural elements implement and evaluate. • selecting appropriate solutions for mechanical recycling problems and sizing example stiffness, corrosion resistance.
Personal Competence	
Social Competence	Students can • arrive at funded work results in heterogenius groups and document them. • provide appropriate feedback and handle feedback on their own performance constructively.
Autonomy	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. - assess possible consequences of their professional activity.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	180 min
Assignment for the Following Curricula	Energy Systems: Core Qualification: Elective Compulsory Aircraft Systems Engineering: Specialisation Cabin Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Air Transportation Systems: Elective Compulsory International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Materials Science: Specialisation Engineering Materials: Elective Compulsory Mechanical Engineering and Management: 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 Renewable Energies: Specialisation Bioenergy Systems: Elective Compulsory Renewable Energies: Specialisation Wind Energy Systems: Elective Compulsory Renewable Energies: Specialisation Solar Energy Systems: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Materials Science: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

Course L1894: Structure and properties of fibre-polymer-composites	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler
Language	EN
Cycle	SoSe
Content	- Microstructure and properties of the matrix and reinforcing materials and their interaction - Development of composite materials - Mechanical and physical properties - Mechanics of Composite Materials - Laminate theory - Test methods - Non destructive testing - Failure mechanisms - Theoretical models for the prediction of properties - Application
Literature	Hall, Clyne: Introduction to Composite materials, Cambridge University Press Daniel, Ishai: Engineering Mechanics of Composites Materials, Oxford University Press Mallick: Fibre-Reinforced Composites, Marcel Deckker, New York

Course L1893: Design with fibre-polymer-composites	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler
Language	EN
Cycle	SoSe
Content	Designing with Composites: Laminate Theory; Failure Criteria; Design of Pipes and Shafts; Sandwich Structures; Notches; Joining Techniques; Compression Loading; Examples
Literature	Konstruieren mit Kunststoffen, Gunter Erhard , Hanser Verlag

Module M1344: Processing of fibre-polymer-composites

Courses

Title	Typ	Hrs/wk	CP
Processing of fibre-polymer-composites (L1895)	Lecture	2	3
From Molecule to Composites Part (L1516)	Project-/problem-based Learning	2	3

Module Responsible	Prof. Bodo Fiedler
Admission Requirements	None
Recommended Previous Knowledge	Knowledge in the basics of chemistry / physics / materials science
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to give a summary of the technical details of the manufacturing processes composites and illustrate respective relationships. They are capable of describing and communicating relevant problems and questions using appropriate technical language. They can explain the typical process of solving practical problems and present related results.
Skills	Students can use the knowledge of fiber-reinforced composites (FRP) and its constituents (fiber / matrix) and define the necessary testing and analysis. They can explain the complex structure-property relationship and the interactions of chemical structure of the polymers, their processing with the different fiber types, including to explain neighboring contexts (e.g. sustainability, environmental protection).
Personal Competence	
Social Competence	Students are able to cooperate in small, mixed-subject groups in order to independently derive solutions to given problems in the context of civil engineering. They are able to effectively present and explain their results alone or in groups in front of a qualified audience. Students have the ability to develop alternative approaches to an engineering problem independently or in groups and discuss advantages as well as drawbacks.
Autonomy	Students are capable of independently solving mechanical engineering problems using provided literature. They are able to fill gaps in as well as extent their knowledge using the literature and other sources provided by the supervisor. Furthermore, they can meaningfully extend given problems and pragmatically solve them by means of corresponding solutions and concepts.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Materials Science: Specialisation Engineering Materials: Elective Compulsory Mechanical Engineering and Management: Specialisation Materials: 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

Course L1895: Processing of fibre-polymer-composites

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler
Language	DE/EN
Cycle	SoSe
Content	Manufacturing of Composites: Hand Lay-Up; Pre-Preg; GMT, BMC; SMC, RIM; Pultrusion; Filament Winding
Literature	Åström: Manufacturing of Polymer Composites, Chapman and Hall

Course L1516: From Molecule to Composites Part	
Typ	Project-/problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler
Language	DE/EN
Cycle	SoSe
Content	Students get the task in the form of a customer request for the development and production of a MTB handlebar made of fiber composites. In the task technical and normative requirements (standards) are given, all other required information come from the lectures and tutorials, and the respective documents (electronically and in conversation). The procedure is to specify in a milestone schedule and allows students to plan tasks and to work continuously. At project end, each group has a made handlebar with approved quality. In each project meeting the design (discussion of the requirements and risks) are discussed. The calculations are analyzed, evaluated and established manufacturing methods are selected. Materials are selected bar will be produced. The quality and the mechanical properties are checked. At the end of the final report created (compilation of the results for the "customers"). After the test during the "customer / supplier conversation" there is a mutual feedback-talk ("lessons learned") in order to ensure the continuous improvement.
Literature	Customer Request ("Handout")

Module M1174: Automation Technology and Systems

Courses

Title	Typ	Hrs/wk	CP
Automation Technology and Systems (L2329)	Lecture	4	4
Automation Technology and Systems (L2331)	Project-/problem-based Learning	1	1
Automation Technology and Systems (L2330)	Recitation Section (small)	1	1

Module Responsible	Prof. Thorsten Schüppstuhl
Admission Requirements	None
Recommended Previous Knowledge	without major course assessment
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students • know the characteristic components of an automation systems and have good understanding of their interaction • know methods for a systematical analysis of automation tasks and are able to use them • have special competences in industrial robot based automation systems
Skills	Students are able to... • analyze complex Automation tasks • develop application based concepts and solutions • design subsystems and integrate into one system • investigate and evaluate safety of machinery • create simple programs for robots and programmable logic controllers • design of circuit for pneumatic applications
Personal Competence	
Social Competence	Students are able to ... - find solutions for automation and handling tasks in groups - develop solutions in a production environment with qualified personnel at technical level and represent decisions.
Autonomy	Students are able to ... • analyze automation tasks independently • generate programs for robots and programmable logic devices autonomously • develop solutions for practice oriented tasks of automation independently • design safety concepts for automation applications • assess consequences of their professional actions and responsibilities
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Production: Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory

Course L2329: Automation Technology and Systems

Typ	Lecture
Hrs/wk	4
CP	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	
Literature	

Course L2331: Automation Technology and Systems	
Typ	Project-/problem-based Learning
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L2330: Automation Technology and Systems	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0563: Robotics

Courses

Title	Typ	Hrs/wk	CP
Robotics: Modelling and Control (L0168)	Lecture	3	3
Robotics: Modelling and Control (L1305)	Recitation Section (large)	2	3

Module Responsible	Prof. Uwe Weltin
Admission Requirements	None
Recommended Previous Knowledge	Fundamentals of electrical engineering Broad knowledge of mechanics Fundamentals of control theory
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to describe fundamental properties of robots and solution approaches for multiple problems in robotics.
Skills	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.
Personal Competence	
Social Competence	Students are able to work goal-oriented in small mixed groups.
Autonomy	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.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	Aircraft Systems Engineering: Specialisation Aircraft Systems: 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: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Robotics and Computer Science: Elective Compulsory

Course L0168: Robotics: Modelling and Control

Typ	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Dr. Martin Gomse, Prof. Uwe Weltin
Language	EN
Cycle	WiSe
Content	Fundamental kinematics of rigid body systems Newton-Euler equations for manipulators Trajectory generation Linear and nonlinear control of robots
Literature	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	
Typ	Recitation Section (large)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Martin Gomse, Prof. Uwe Weltin
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0771: Flight Physics

Courses

Title	Typ	Hrs/wk	CP
Aerodynamics and Flight Mechanics I (L0727)	Lecture	3	3
Flight Mechanics II (L0730)	Lecture	2	2
Flight Mechanics II (L0731)	Recitation Section (large)	1	1

Module Responsible	Prof. Frank Thielecke
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Aviation
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	
Skills	
Personal Competence	
Social Competence	
Autonomy	
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 Minutes (WS) + 90 Minutes (SS)
Assignment for the Following Curricula	Aircraft Systems Engineering: Core Qualification: Compulsory International Management and Engineering: Specialisation II. Aviation Systems: 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 Aircraft Systems Engineering: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

Course L0727: Aerodynamics and Flight Mechanics I

Typ	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Frank Thielecke, Dr. Ralf Heinrich, Mike Montel
Language	DE
Cycle	WiSe
Content	• Aerodynamics (fundamental equations of aerodynamics; compressible and incompressible flows; airfoils and wings; viscous flows) • Flight Mechanics (Equations of motion; flight performance; control surfaces; derivatives; lateral stability and control; trim conditions; flight maneuvers)
Literature	• Schlichting, H.; Truckenbrodt, E.: Aerodynamik des Flugzeuges I und II • Etkin, B.: Dynamics of Atmospheric Flight • Sachs/Hafer: Flugmechanik • Brockhaus: Flugregelung • J.D. Anderson: Introduction to flight

Course L0730: Flight Mechanics II	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Frank Thielecke, Mike Montel
Language	DE
Cycle	SoSe
Content	• stationary asymmetric flight • dynamics of lateral movement • methods of flight simulation • eyperimental methods of flight mechanics • model validation using system identification • wind tunnel techniques
Literature	• Schlichting, H.; Truckenbrodt, E.: Aerodynamik des Flugzeuges I und II • Etkin, B.: Dynamics of Atmospheric Flight • Sachs/Hafer: Flugmechanik • Brockhaus: Flugregelung • J.D. Anderson: Introduction to flight

Course L0731: Flight Mechanics II	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Frank Thielecke, Mike Montel
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0815: Product Planning

Courses

Title	Typ	Hrs/wk	CP
Product Planning (L0851)	Project-/problem-based Learning	3	3
Product Planning Seminar (L0853)	Project-/problem-based Learning	2	3

Module Responsible	Prof. Cornelius Herstatt
Admission Requirements	None
Recommended Previous Knowledge	Good basic-knowledge of Business Administration
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students will gain insights into: • Product Planning ◦ Process ◦ Methods • Design thinking ◦ Process ◦ Methods ◦ User integration
Skills	Students will gain deep insights into: • Product Planning ◦ Process-related aspects ◦ Organisational-related aspects ◦ Human-Ressource related aspects ◦ Working-tools, methods and instruments ◦
Personal Competence	
Social Competence	• Interact within a team • Raise awareness for globabl issues
Autonomy	• Gain access to knowledge sources • Interpret complex cases • Develop presentation skills
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	**Compulsory** / **Bonus** / **Form** / **Description** Yes / 20 % / Subject theoretical and practical work /
Examination	Written exam
Examination duration and scale	90 minutes
Assignment for the Following Curricula	Global Innovation Management: Core Qualification: Compulsory International Management and Engineering: Specialisation I. Electives Management: Elective Compulsory Mechanical Engineering and Management: Specialisation 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 Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

Course L0851: Product Planning	
Typ	Project-/problem-based Learning
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Cornelius Herstatt
Language	EN
Cycle	WiSe
Content	Product Planning Process 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.: • Systematic scanning of markets for innovation opportunities • Understanding strengths/weakness and specific core competences of a firm as platforms for innovation • Exploring relevant sources for innovation (customers, suppliers, Lead Users, etc.) • Developing ideas for radical innovation, relying on the creativeness of employees, using techniques to stimulate creativity and creating a stimulating environment • Transferring ideas for innovation into feasible concepts which have a high market attractively Voluntary presentations in the third hour (articles / case studies) - Guest lectures by researchers - Lecture on Sustainability with frequent reference to current research - Permanent reference to current research Examination: In addition to the written exam at the end of the module, students have to attend the PBL-exercises and prepare presentations in groups in order to pass the module. Additionally, students have the opportunity to present research papers on a voluntary base. With these presentations it is possible to gain a bonus of max. 20% for the exam. However, the bonus is only valid if the exam is passed without the bonus.
Literature	Ulrich, K./Eppinger, S.: Product Design and Development, 2nd. Edition, McGraw-Hill 2010

Course L0853: Product Planning Seminar	
Typ	Project-/problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Cornelius Herstatt
Language	EN
Cycle	WiSe
Content	Seminar is integrative part of the Module Product Planning (for content see lecture) and can not be choosen independantly.
Literature	See lecture information "Product Planning".

Module M0830: Environmental Protection and Management

Courses			
Title	**Typ**	**Hrs/wk**	**CP**
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

Module Responsible	Prof. Ralf Otterpohl
Admission Requirements	None
Recommended Previous Knowledge	• Good knowledge in Technologies for Environmental Protection (end-of-pipe, integrated solutions) • Good knowledge of the relevant Environmental Legislation • Basic knowledge of instruments for Environmental Assessment
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	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.
Skills	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.
Personal Competence	
Social Competence	The students can work together in international groups.
Autonomy	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.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Bioprocess Engineering: Specialisation C - Bioeconomic Process Engineering, Focus Management and Controlling: Elective Compulsory Energy and Environmental Engineering: Specialisation Environmental Engineering: Elective Compulsory Environmental Engineering: Core Qualification: 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	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	WiSe
Content	The lecture focusses on: • The Regulatory Framework • Pollution & Impacts, Characteristics of Pollutants • Approaches of Integrated Pollution Control • Sevilla Process, Best Available Technologies & BREF Documents • Case Studies: paper industry, cement industry, automotive industry • Field Trip
Literature	**Förstner**, Ulrich (1998): Integrated Pollution Control, Springer-Verlag Berlin Heidelberg, ISBN 978-3-642-80313-0 **Shen**, Thomas T. (1999): Industrial Pollution Prevention, Springer-Verlag Berlin Heidelberg, ISBN 978-3-540-65208-3

Course L0387: Health, Safety and Environmental Management	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Hans-Joachim Nau
Language	EN
Cycle	WiSe
Content	• 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
Literature	C. Stephan: Industrial Health, Safety and Environmental Management, MV-Verlag, Münster, 2007/2012 (can be found in the library under GTG 315) Exercises can be downloaded from StudIP

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

Module M0867: Production Planning & Control and Digital Enterprise

Courses

Title	Typ	Hrs/wk	CP
The Digital Enterprise (L0932)	Lecture	2	2
Production Planning and Control (L0929)	Lecture	2	2
Production Planning and Control (L0930)	Recitation Section (small)	1	1
Exercise: The Digital Enterprise (L0933)	Recitation Section (small)	1	1

Module Responsible	Prof. Hermann Lödding
Admission Requirements	None
Recommended Previous Knowledge	Fundamentals of Production and Quality Management
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can explain the contents of the module in detail and take a critical position to them.
Skills	Students are capable of choosing and applying models and methods from the module to industrial problems.
Personal Competence	
Social Competence	Students can develop joint solutions in mixed teams and present them to others.
Autonomy	-
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	180 Minuten
Assignment for the Following Curricula	International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Logistics, Infrastructure and Mobility: Specialisation Production and Logistics: 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: Compulsory Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Production: 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 L0932: The Digital Enterprise

Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Axel Friedewald
Language	DE
Cycle	WiSe
Content	Due to the developments of Industry 4.0, digitalization and interconnectivity become a strategic advantage for companies in the international competition. This lecture focuses on the relevant modules and enables the participants to evaluate current developments in this context. In particular, knowledge management, simulation, process modelling and virtual technologies are covered. Content: • Business Process Management and Data Modelling, Simulation • Knowledge and Competence Management • Process Management (PPC, Workflow Management) • Computer Aided Planning (CAP) and NC-Programming • Virtual Reality (VR) and Augmented Reality (AR) • Computer Aided Quality Management (CAQ) • Industry 4.0
Literature	Scheer, A.-W.: ARIS - vom Geschäftsprozeß zum Anwendungssystem. Springer-Verlag, Berlin 4. Aufl. 2002 Schuh, G. et. al.: Produktionsplanung und -steuerung, Springer-Verlag. Berlin 3. Auflage 2006 Becker, J.; Luczak, H.: Workflowmanagement in der Produktionsplanung und -steuerung. Springer-Verlag, Berlin 2004 Pfeifer, T; Schmitt, R.: Masing Handbuch Qualitätsmanagement. Hanser-Verlag, München 5. Aufl. 2007 Kühn, W.: Digitale Fabrik. Hanser-Verlag, München 2006

Course L0929: Production Planning and Control	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	WiSe
Content	• Models of Production and Inventory Management • Production Programme Planning and Lot Sizing • Order and Capacity Scheduling • Selected Strategies of PPC • Manufacturing Control • Production Controlling • Supply Chain Management
Literature	• Vorlesungsskript • Lödding, H: Verfahren der Fertigungssteuerung, Springer 2008 • Nyhuis, P.; Wiendahl, H.-P.: Logistische Kennlinien, Springer 2002

Course L0930: Production Planning and Control	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Hermann Lödding
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L0933: Exercise: The Digital Enterprise	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Axel Friedewald
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	Siehe korrespondierende Vorlesung See interlocking course

Module M0962: Sustainability and Risk Management

Courses

Title	Typ	Hrs/wk	CP
Safety, Reliability and Risk Assessment (L1145)	Seminar	2	3
Environment and Sustainability (L0319)	Lecture	2	3

Module Responsible	Prof. Kerstin Kuchta
Admission Requirements	None
Recommended Previous Knowledge	none
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to describe single techniques and to give an overview for the field of safety and risk assessment as well as environmental and sustainable engineering, in detail: • basics in safety and reliability of technical facilities • safety and reliability analysis methods • risk assessment • Production and usage of bio-char • energy production and supply • sustainable product design
Skills	Students are able apply interdisciplinary system-oriented methods for risk assessment and sustainability reporting. They can evaluate the effort and costs for processes and select economically feasible treatment concepts.
Personal Competence	
Social Competence	
Autonomy	Students can gain knowledge of the subject area from given sources and transform it to new questions. Furthermore, they can define targets for new application or research-oriented duties in for risk management and sustainability concepts accordance with the potential social, economic and cultural impact.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and scale	Elaboration and presentation (45 minutes in groups)
Assignment for the Following Curricula	Civil Engineering: Core Qualification: Compulsory Bioprocess Engineering: Specialisation C - Bioeconomic Process Engineering, Focus Management and Controlling: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: 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: Core Qualification: Compulsory

Course L1145: Safety, Reliability and Risk Assessment

Typ	Seminar
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Marco Ritzkowski
Language	DE
Cycle	WiSe
Content	An introduction in safety and risk assessment is given and some typical problems of structural and environmental engineering are treated: • basics in safety and reliability of technical facilities • safety and reliability analysis methods • risk assessment • practical examples and excursions • discussions and presentations
Literature	- Vorlesungsunterlagen - Schneider, J., Schlatter, H.P.: Sicherheit und Zuverlässigkeit im Bauwesen. www.risksafety.ch/files/**sicherheit**_und_zuverlaessigkeit.pdf

Course L0319: Environment and Sustainability	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Kerstin Kuchta
Language	EN
Cycle	WiSe
Content	This course presents actual methodologies and examples of environmental relevant, sustainable technologies, concepts and strategies in the field of energy supply, product design, water supply, waste water treatment or mobility. The following list show examples. Production and Usage of Bio-char Engergy production with algae Environmental product design Clean Development mechanism (CDM) Democracy and Energy New Concepts for a sustainable Energy Supply Recycling of Wind Turbines Alternative Mobility Disposal of Nuclear Wastes Waste2Energy Offshore Wind energy
Literature	Wird in der Veranstaltung bekannt gegeben.

Module M1024: Methods of Integrated Product Development

Courses

Title	Typ	Hrs/wk	CP
Integrated Product Development II (L1254)	Lecture	3	3
Integrated Product Development II (L1255)	Project-/problem-based Learning	2	3

Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge of Integrated product development and applying CAE systems
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	After passing the module students are able to: • explain technical terms of design methodology, • describe essential elements of construction management, • describe current problems and the current state of research of integrated product development.
Skills	After passing the module students are able to: • select and apply proper construction methods for non-standardized solutions of problems as well as adapt new boundary conditions, • solve product development problems with the assistance of a workshop based approach, • choose and execute appropriate moderation techniques.
Personal Competence	
Social Competence	After passing the module students are able to: • prepare and lead team meetings and moderation processes, • work in teams on complex tasks, • represent problems and solutions and advance ideas.
Autonomy	After passing the module students are able to: • give a structured feedback and accept a critical feedback, • implement the accepted feedback autonomous.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Oral exam
Examination duration and scale	30 Minuten
Assignment for the Following Curricula	Aircraft Systems Engineering: Specialisation Cabin Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Air Transportation Systems: Elective Compulsory International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory

Course L1254: Integrated Product Development II	
Typ	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	**Lecture** The lecture extends and enhances the learned content of the module “Integrated Product Development and lightweight design” and is based on the knowledge and skills acquired there. Topics of the course include in particular: • Methods of product development, • Presentation techniques, • Industrial Design, • Design for variety • Modularization methods, • Design catalogs, • Adapted QFD matrix, • Systematic material selection, • Assembly oriented design, Construction management • CE mark, declaration of conformity including risk assessment, • Patents, patent rights, patent monitoring • Project management (cost, time, quality) and escalation principles, • Development management for mechatronics, • Technical Supply Chain Management. **Exercise (PBL)** In the exercise the content presented in the lecture “Integrated Product Development II” and methods of product development and design management will be enhanced. Students learn an independently moderated and workshop based approach through industry related practice examples to solve complex and currently existing issues in product development. They will learn the ability to apply important methods of product development and design management autonomous and acquire further expertise in the field of integrated product development. Besides personal skills, such as teamwork, guiding discussions and representing work results will be acquired through the workshop based structure of the event under its own planning and management.
Literature	• Andreasen, M.M., Design for Assembly, Berlin, Springer 1985. • Ashby, M. F.: Materials Selection in Mechanical Design, München, Spektrum 2007. • Beckmann, H.: Supply Chain Management, Berlin, Springer 2004. • Hartmann, M., Rieger, M., Funk, R., Rath, U.: Zielgerichtet moderieren. Ein Handbuch für Führungskräfte, Berater und Trainer, Weinheim, Beltz 2007. • Pahl, G., Beitz, W.: Konstruktionslehre, Berlin, Springer 2006. • Roth, K.H.: Konstruieren mit Konstruktionskatalogen, Band 1-3, Berlin, Springer 2000. • Simpson, T.W., Siddique, Z., Jiao, R.J.: Product Platform and Product Family Design. Methods and Applications, New York, Springer 2013.

Course L1255: Integrated Product Development II	
Typ	Project-/problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1155: Aircraft Cabin Systems

Courses

Title	Typ	Hrs/wk	CP
Aircraft Cabin Systems (L1545)	Lecture	3	4
Aircraft Cabin Systems (L1546)	Recitation Section (large)	1	2

Module Responsible	Prof. Ralf God
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge in: • Mathematics • Mechanics • Thermodynamics • Electrical Engineering • Control Systems
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to: • describe cabin operations, equipment in the cabin and cabin Systems • explain the functional and non-functional requirements for cabin Systems • elucidate the necessity of cabin operating systems and emergency Systems • assess the challenges human factors integration in a cabin environment
Skills	Students are able to: • design a cabin layout for a given business model of an Airline • design cabin systems for safe operations • design emergency systems for safe man-machine interaction • solve comfort needs and entertainment requirements in the cabin
Personal Competence	
Social Competence	Students are able to: • understand existing system solutions and discuss their ideas with experts
Autonomy	Students are able to: • Reflect the contents of lectures and expert presentations self-dependent
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 Minutes
Assignment for the Following Curricula	Electrical Engineering: Specialisation Control and Power Systems Engineering: Elective Compulsory Energy Systems: Specialisation Energy Systems: Elective Compulsory Aircraft Systems Engineering: Core Qualification: Compulsory International Management and Engineering: Specialisation II. Aviation Systems: 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 Aircraft Systems Engineering: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

Course L1545: Aircraft Cabin Systems	
Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Ralf God
Language	DE
Cycle	WiSe
Content	The objective of the lecture with the corresponding exercise is the acquisition of knowledge about aircraft cabin systems and cabin operations. A basic understanding of technological and systems engineering effort to maintain an artificial but comfortable and safe travel and working environment at cruising altitude is to be achieved. The course provides a comprehensive overview of current technology and cabin systems in modern passenger aircraft. The Fulfillment of requirements for the cabin as the central system of work are covered on the basis of the topics comfort, ergonomics, human factors, operational processes, maintenance and energy supply: • Materials used in the cabin • Ergonomics and human factors • Cabin interior and non-electrical systems • Cabin electrical systems and lights • Cabin electronics, communication-, information- and IFE-systems • Cabin and passenger process chains • RFID Aircraft Parts Marking • Energy sources and energy conversion
Literature	- Skript zur Vorlesung - Jenkinson, L.R., Simpkin, P., Rhodes, D.: Civil Jet Aircraft Design. London: Arnold, 1999 - Rossow, C.-C., Wolf, K., Horst, P. (Hrsg.): Handbuch der Luftfahrzeugtechnik. Carl Hanser Verlag, 2014 - Moir, I., Seabridge, A.: Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration, Wiley 2008 - Davies, M.: The standard handbook for aeronautical and astronautical engineers. McGraw-Hill, 2003 - Kompendium der Flugmedizin. Verbesserte und ergänzte Neuauflage, Nachdruck April 2006. Fürstenfeldbruck, 2006 - Campbell, F.C.: Manufacturing Technology for Aerospace Structural Materials. Elsevier Ltd., 2006

Course L1546: Aircraft Cabin Systems	
Typ	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Ralf God
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1025: Fluidics

Courses

Title	Typ	Hrs/wk	CP
Fluidics (L1256)	Lecture	2	3
Fluidics (L1371)	Project-/problem-based Learning	1	2
Fluidics (L1257)	Recitation Section (large)	1	1

Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous Knowledge	Good knowledge of mechanics (stereo statics, elastostatics, hydrostatics, kinematics and kinetics), fluid mechanics, and engineering design
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	After passing the module students are able to • explain structures and functionalities of hydrostatic, pneumatic, and hydrodynamic components, • explain the interaction of hydraulic components in hydraulic systems, • explain open and closed loop control of hydraulic systems, • describe functioning and applications of hydrodynamic torque converters, brakes and clutches as well as centrifugal pumps and aggregates in plant technology
Skills	After passing the module students are able to • analyse and assess hydraulic and pneumatic components and systems, • design and dimension hydraulic systems for mechanical applications, • perform numerical simulations of hydraulic systems based on abstract problem definitions, • select and adapt pump characteristic curves for hydraulic systems • dimension hydrodynamic torque converters and brakes for mechanical aggregates.
Personal Competence	
Social Competence	After passing the module students are able to • discuss and present functional context in groups, • organise teamwork autonomously.
Autonomy	After passing the module students are able to • obtain necessary knowledge for the simulation.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	**Compulsory**: Yes; **Bonus**: None; **Form**: Attestation; **Description**: Simulation hydrostatischer Systeme
Examination	Written exam
Examination duration and scale	90
Assignment for the Following Curricula	International Management and Engineering: Specialisation II. Mechatronics: Elective Compulsory International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Product Development and Production: Elective Compulsory

Course L1256: Fluidics	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	**Lecture** Hydrostatics • physical fundamentals • hydraulic fluids • hydrostatic machines • valves • components • hydrostatic transmissions • examples from industry Pneumatics • generation of compressed air • pneumatic motors • Examples of use Hydrodynamics • physical fundamentals • hydraulic continous-flow machines • hydrodynamic transmissions • interoperation of motor and transmission **Exercise** Hydrostatics • reading and design of hydraulic diagrams • dimensioning of hydrostatic traction and working drives • performance calculation Hydrodynamics • calculation / dimensioning of hydrodynamic torque converters • calculation / dimensioning of centrifugal pumps • creating and reading of characteristic curves of pumps and systems Field trip • field trip to a regional company from the hydraulic industry. **Exercise** Numerical simulation of hydrostatic systems • getting to know a numerical simulation environment for hydraulic systems • transformation of a task into a simulation model • simulation of common components • variation of simulation parameters • using simulations for system dimensioning and optimisation • (partly) self-organised teamwork
Literature	Bücher • Murrenhoff, H.: Grundlagen der Fluidtechnik - Teil 1: Hydraulik, Shaker Verlag, Aachen, 2011 • Murrenhoff, H.: Grundlagen der Fluidtechnik - Teil 2: Pneumatik, Shaker Verlag, Aachen, 2006 • Matthies, H.J. Renius, K.Th.: Einführung in die Ölhydraulik, Teubner Verlag, 2006 • Beitz, W., Grote, K.-H.: Dubbel - Taschenbuch für den Maschinenbau, Springer-Verlag, Berlin, aktuelle Auflage Skript zur Vorlesung

Course L1371: Fluidics	
Typ	Project-/problem-based Learning
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1257: Fluidics	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1183: Laser systems and methods of manufacturing design and analysis

Courses

Title	Typ	Hrs/wk	CP
Laser Systems and Process Technologies (L1612)	Lecture	2	3
Methods for Analysing Production Processes (L0876)	Lecture	2	3

Module Responsible	Prof. Wolfgang Hintze
Admission Requirements	None
Recommended Previous Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	
Skills	
Personal Competence	
Social Competence	
Autonomy	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	180 min
Assignment for the Following Curricula	Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Production: 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 L1612: Laser Systems and Process Technologies

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Claus Emmelmann
Language	EN
Cycle	WiSe
Content	• Fundamentals of laser technology • Laser beam sources: CO2-, Nd:YAG-, Fiber- and Diodelasers • Laser system technology: beam forming, beam guidance systems, beam motion and beam control • Laser-based manufacturing technologies: generation, marking, cutting, joining, surface treatment • Quality assurance and economical aspects of laser material processing • Markets and Applications of laser technology • Student group exercises
Literature	• Hügel, H. , T. Graf: Laser in der Fertigung : Strahlquellen, Systeme, Fertigungsverfahren, 3. Aufl., Vieweg + Teubner Wiesbaden 2014. • Eichler, J., Eichler. H. J.: Laser: Bauformen, Strahlführung, Anwendungen, 7. Aufl., Springer-Verlag Berlin Heidelberg 2010. • Steen W. M.; Mazumder J.: Laser material processing, 4th Edition, Springer-Verlag London 2010. • J.C. Ion: Laser processing of engineering materials: principles, procedure and industrial applications, Elsevier Butterworth-Heinemann 2005. • Gebhardt, A.: Understanding additive manufacturing, München [u.a.] Hanser 2011

Course L0876: Methods for Analysing Production Processes	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hintze
Language	DE
Cycle	WiSe
Content	• Modelling and simulation of maching and forming processes • Numerical simulation of forces, temperatures, deformation in machining • Analysis of vibration problems in maching (chatter, modal analysis,..) • Knowledge based process planning • Design of experiments • Machinability of nonmetallic materials • Analysis of interaction between maching process and machine tool systems with regard to process stabiltity and quality • Simulation of maching processes by virtual reality methods
Literature	Tönshoff, H.K.; Denkena, B.; Spanen Grundlagen, Springer (2004) Klocke, F.; König, W.; Fertigungsverfahren Umformen, Springer (2006) Weck, M.; Werkzeugmaschinen Fertigungssysteme 3, Springer (2001) Weck, M.; Werkzeugmaschinen Fertigungssysteme 5, Springer (2001)

Module M1342: Polymers

Courses

Title	Typ	Hrs/wk	CP
Structure and Properties of Polymers (L0389)	Lecture	2	3
Processing and design with polymers (L1892)	Lecture	2	3

Module Responsible	Dr. Hans Wittich
Admission Requirements	None
Recommended Previous Knowledge	Basics: chemistry / physics / material science
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can use the knowledge of plastics and define the necessary testing and analysis. They can explain the complex relationships structure-property relationship and the interactions of chemical structure of the polymers, including to explain neighboring contexts (e.g. sustainability, environmental protection).
Skills	Students are capable of - using standardized calculation methods in a given context to mechanical properties (modulus, strength) to calculate and evaluate the different materials. - selecting appropriate solutions for mechanical recycling problems and sizing example stiffness, corrosion resistance.
Personal Competence	
Social Competence	Students can - arrive at funded work results in heterogenius groups and document them. - provide appropriate feedback and handle feedback on their own performance constructively.
Autonomy	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. - assess possible consequences of their professional activity.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	180 min
Assignment for the Following Curricula	Materials Science: Specialisation Engineering Materials: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Materials Science: Elective Compulsory

Course L0389: Structure and Properties of Polymers	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Hans Wittich
Language	DE
Cycle	WiSe
Content	- Structure and properties of polymers - Structure of macromolecules Constitution, Configuration, Conformation, Bonds, Synthesis, Molecular weihght distribution - Morphology amorph, crystalline, blends - Properties Elasticity, plasticity, viscoelacity - Thermal properties - Electrical properties - Theoretical modelling - Applications
Literature	Ehrenstein: Polymer-Werkstoffe, Carl Hanser Verlag

Course L1892: Processing and design with polymers	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler, Dr. Hans Wittich
Language	DE/EN
Cycle	WiSe
Content	Manufacturing of Polymers: General Properties; Calendering; Extrusion; Injection Moulding; Thermoforming, Foaming; Joining Designing with Polymers: Materials Selection; Structural Design; Dimensioning
Literature	Osswald, Menges: Materials Science of Polymers for Engineers, Hanser Verlag Crawford: Plastics engineering, Pergamon Press Michaeli: Einführung in die Kunststoffverarbeitung, Hanser Verlag Konstruieren mit Kunststoffen, Gunter Erhard , Hanser Verlag

Module M1185: Technical Complementary Course for PEPMS (according to Subject Specific Regulations)

Courses

Title	Typ	Hrs/wk	CP

Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous Knowledge	See selected module according to FSPO
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	see selected module according to FSPO
Skills	see selected module according to FSPO
Personal Competence	
Social Competence	see selected module according to FSPO
Autonomy	see selected module according to FSPO
Workload in Hours	Depends on choice of courses
Credit points	6
Assignment for the Following Curricula	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

Thesis

Module M-002: Master Thesis

Courses			
Title	**Typ**	**Hrs/wk**	**CP**

Module Responsible	Professoren der TUHH
Admission Requirements	• According to General Regulations §21 (1): At least 60 credit points have to be achieved in study programme. The examinations board decides on exceptions.
Recommended Previous Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• The students can use specialized knowledge (facts, theories, and methods) of their subject competently on specialized issues. • 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. • The students can place a research task in their subject area in its context and describe and critically assess the state of research.
Skills	The students are able: • To select, apply and, if necessary, develop further methods that are suitable for solving the specialized problem in question. • 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. • To develop new scientific findings in their subject area and subject them to a critical assessment.
Personal Competence	
Social Competence	Students can • Both in writing and orally outline a scientific issue for an expert audience accurately, understandably and in a structured way. • 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.
Autonomy	Students are able: • To structure a project of their own in work packages and to work them off accordingly. • To work their way in depth into a largely unknown subject and to access the information required for them to do so. • To apply the techniques of scientific work comprehensively in research of their own.
Workload in Hours	Independent Study Time 900, Study Time in Lecture 0
Credit points	30
Course achievement	None
Examination	Thesis
Examination duration and scale	According to General Regulations
Assignment for the Following Curricula	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 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 Mathematical Modelling in Engineering: Theory, Numerics, Applications: 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 Teilstudiengang Lehramt Metalltechnik: Thesis: Compulsory Theoretical Mechanical Engineering: Thesis: Compulsory Process Engineering: Thesis: Compulsory Water and Environmental Engineering: Thesis: Compulsory Certification in Engineering & Advisory in Aviation: Thesis: Compulsory